Illinois U Library

JOURNAL OF CYCLE RESEARCH

Vol. 2 No. 4

FALL 1953

JOURNAL OF CYCLE RESEARCH

LEONARD W. WING, EDITOR

CONTENTS, FALL 1953

Page

THE 9.2- AND 8.5-YEAR CYCLES IN PIG IRON PRICES, by Edward R. Dewey . . 79

THE SUNSPOT CYCLE A.D. 301—1950, by D. Justin Shove 90

DATES OF BREAK-UP AND FREEZE-UP OF THE ST JOHN RIVER AT FREDERICTON N. B., by Bruce S. Wright 94

FLOOD-STAGE RECORDS OF THE RIVER NILE, by C. S. Jarvis 96

STANDARD QUARTER-YEAR NUMBERS. 101

The Journal of Cycle Research is published quarterly at 9 E 77th St., New York 21, N. Y., by

THE FOUNDATION FOR THE STUDY OF CYCLES

The Foundation is a not-for-profit corporation, the board of directors of which consists of the following committee:

UNITED STATES OF AMERICA

Copley Amory, Chairman Emeritus

Charles Greeley Abbot
Research Associate
Smithsonian Institution

Harold Elmer Anthony
Chairman and Curator
Department of Mammals
American Museum of Natural History

George Baekeland, Chairman of the
Committee of the Foundation
The Bakelite Corporation

Harold Gardiner Bowen
Vice, Admiral, U.S. Navy, Retired
Executive Director, Thomas Alva
Edison Foundation

Verne Burnett
Partner
Verne Burnett Associate

Hon. W. Cameron Forbes
Member, Board of Trustees
Carnegie Institution of Washington;
Life Member of the Corporation,
Massachusetts Institute of Technology

Webster N. Jones
Vice President
Carnegie Institute of Technology

Daniel Trembly MacDougal
Former Director
Department of Botanical Research and
Laboratory of Plant Physiology
Carnegie Institution of Washington

John Quincy Stewart
Professor of Astronomical Physics
Princeton University

CANADA

Hon. Charles Camsell
Former Commissioner
Northwest Territories

Frank Cyril James
Principal and Vice-Chancellor
McGill University

GREAT BRITAIN

Sir Patrick Ashley Cooper
Governor
Hudson's Bay Company

Julian Sorell Huxley
Former Director General
United Nations Educational, Scientific and Cultural Organizations

Edward R. Dewey, Director

Subscription to the Journal of Cycle Research costs $5.00 a year. Single copies are $1.25 each.

THE 9.2- AND 8.5-YEAR CYCLES IN PIG IRON PRICES

by Edward R. Dewey, Director
Foundation for the Study of Cycles

Pig iron prices in the United States, 1784-1953, have tended to fluctuate rhythmically in a cycle which averages about 9.2 years in length.

We do not know why pig iron prices behave this way. Three possible explanations suggest themselves.

One, the seventeen consecutive cycles (see Fig. 2) could of course have come about as a result of seventeen discrete *random* events—each event important enough to cause prices to rise for several years; each event just happening, by accident, to come at about a 9-year interval from the one before.

Or, two, there could be something in the way prices behave so that, purely as a matter of *internal dynamics,* when prices get too high they tend to fall for several years to a level which, relatively, is too low. Conversely, perhaps when prices are too low they rise until they are too high again; and so on in unbroken alternating sequence, with a rhythm of about 9.2 years for the complete cycle.

Or, three, theoretically at least, there could be a rhythmic *environmental force* with an average period of wave length of 9.2 years which in some way affects the people who, in last analysis, directly or indirectly, make the prices go up and down.

These various conjectures will be examined later. Let us first, however, concern ourselves with fact.

Pig iron prices, by quarters, 1st quarter 1784 through 4th quarter 1953[1] are plotted on ratio scale in Fig. 1. Data for the Civil War period, and for the period from 1933 through 1953, are plotted both in currency and in gold (for 1933—1953, black market quotations). However, as the data adjusted to a gold basis are not used in the analysis, the matter of conversion to gold may be ignored.

Here and there a rough tendency for major ups and major downs to alternate at a little over 9-year intervals (from crest to crest or from trough to trough) can be seen by even an untrained eye. Note for example the period 1815 to 1864. However, any tendency toward regularity that may be present in these figures is obscured by (a) secular (long term) trend, (b) inflation, defined for this purpose as the difference between prices in paper and prices in gold, (c) other rhythmic behaviors, if any, and (d) other factors which are strictly random in their incidence.

These various distorting elements can be minimized somewhat by various statistical manipulations. The simplest manipulation to use, and one adequate for our purposes, is (1) to compute a trend, (2) to express the data as deviations (departures; differences) from the trend, and (3) to smooth these deviations so as to iron out minor fluctuations. These manipulations have been made. The results have been plotted in Fig. 2. The tendency for major ups to be followed by major downs in a cycle averaging 9.2 years in length is clearly evident. To aid the eye, a rigid 9.2-year periodicity of zigzag shape has been added.

The trend used was a 41-quarter (10¼-year) moving average of the logs of the data; the smoothing was a 17-quarter (4¼-year) moving average of the deviations (in logs).

Any statistician will recognize in these techniques the standard method for isolating and more easily observing seasonal variation—except that instead of obtaining deviations from a 12-month moving average, as one would do to bring a 12-month or seasonal pattern into relief, I have used a moving average of roughly the same length as the 9.2-year cycle being investigated.

Was the rhythmic undulation, observable in Fig. 2, created by the manipulation? No, actually it was minimized. But, *relative* to the other fluctuations, the 9.2-year tendency present in the original data was enhanced, because some of the other fluctuations were minimized more.

Deviations from trend do not need to be computed in order to see the 9.2-year cycle. A mere smoothing of the original data would have been enough to make the 9.2-year cycle easier to see throughout the entire 170 years. However, long term undulations or "ground swells" would have remained in the curve, and the various cycles would not have been quite as easy to average.

---

[1] The values used are the quarterly averages of the monthly values which were used to construct the annual values published by Alla Malinowski in "Pig Iron Prices in the United States, 1784—1951." *Journal of Cycle Research,* Vol. 1, No. 3, Spring 1952.

Because we are going to spend several minutes considering the manipulated data shown in Fig. 2, and because we are going to draw some conclusions from our considerations, it may be well to take a few minutes to belabor the point that the manipulations do not create the rhythm.

The manipulation of the data involved three computations: (1) computation of a 41-quarter moving average of the logs of the data, (2) computation of the difference between the logs of the data and their 41-quarter moving average, and (3) a smoothing of these differences by means of a 17-quarter moving average.

A 41-quarter moving average is the average (arithmetic mean) of the first 41 values of the series plotted at the mid point—the 21st quarter; the average of the second through the 42nd values of the series plotted at the 22nd quarter; and so on. A 17-quarter moving average is the average of the first 17 values of the series plotted at the 9th quarter, an average of the second through the 18th value of the series plotted at the 10th quarter; and so on.

If you will take the trouble to construct periodicities of various lengths such as 7, 8, 9, 10, 11, and 12 years, run 9-year moving averages through each, and compute and plot the difference between the original data and the moving average, you will observe that the difference between the 7-year periodicity and its 9-year moving average shows a 7-year periodicity; the difference between the 8-year periodicity and its 9-year moving average shows an 8-year periodicity; and so on.

Furthermore, if you will take the trouble to construct a series of random numbers, either with or without serial correlation, run a moving average of any length through this series of random numbers, and compute and plot the differences between the random numbers and the moving average, you will find that the differences, like the original figures, fluctuate in cycles of random length.

That is to say, it is the length of the cycle or the randomness in the original figures and not the existence or the length of the moving average which determines the length of the cycle in the differences between the original figures and the moving average. Insofar as the original cycles are rhythmic or random the cycles in the differences from the moving average will be rhythmic or random also.

On the other hand, deviations from a moving average always minimize trend and oscillations with a period or wave length longer than the length of the moving average. This is because a moving average of any length rides up and down with trend or any oscillations longer than its own length. Consequently, relatively speaking, deviations from a moving average almost always show oscillation up to the length of the moving average more clearly than they are shown in the original data. The exception, of course, occurs where the original data contained no trend and no oscillations longer than the length of the moving average.

As for the effect of smoothing, if you will take the trouble to construct periodicities of various lengths, such as 7, 8, 9, 10, 11, and 12 years, run a short moving average, say three years long, through each, and plot the smoothed values, you will see that the smoothing in no way affects the cycle. The smoothed 7-year cycle continues to be 7 years long. The smoothed 8-year cycle continues to be 8 years long, and so on, regardless of the smoothing process.

Also, if you will take a series of random numbers either with or without serial correlation and smooth them with, let us say, a 3-item moving average, you will find that the *period* or wave length of the fluctuations continue to be random, although of course serial correlation will have been introduced or increased.

Returning now to Fig. 2, an averaging process shows that the rigid periodicity (a cycle of uniform fixed length) which most nearly fits the observed behavior is about 9.20 years in length.

The typical amplitude of the 9.2-year cycle in the actual prices is 112.2% of its axis at time of crest, 89.1% of its axis at time of trough.

The shape of the typical wave, as nearly as I have been able to determine it, is zigzag when the original data are expressed in logarithms. In the smoothed deviations, of course, the tops and bottoms are rounded over. The shape of the typical wave is symmetrical relative to both the X and the Y axes.

Crests of the ideal cycle fall at the first quarter of 1790 and every 9.20 years thereafter. Troughs fall ideally 4.6 years after crests. The ideal time for the latest trough was March 1951; for the next crest it will be October 1955.

The 8.5-Year Cycle

Let us now adjust the deviations from trend shown in Fig. 2 for the effect of the typical 9.2-year cycle. This adjustment is made in the same way in which one would adjust a series of monthly figures for a typical 12-month or seasonal cycle. The results of the adjustment are shown in Fig. 3.

It is obvious by inspection that the major peaks and troughs of Fig. 3 tend to recur at about 8½ year intervals. As nearly as I have been able to measure it, the length of the 8½-year cycle is typically 8.53 years from crest to crest or from trough to trough. A rigid 8.53-year periodicity of typical timing and amplitude has been added by means of a broken zigzag line.

The strength of the 8½-year cycle in the actual prices is typically about half that of the 9.2-year cycle, namely, 106.4% of its axis at time of crest, 94.0% of its axis at time of trough. The shape, like that of the 9.2-year cycle, is symmetrical and seems to be zigzag when the data are expressed in logarithms.

Crests fall ideally at the first quarter of 1788 and every 8.53 years thereafter. Troughs fall ideally 4.26 years after crests. The ideal time for the latest crest of the 8½-year cycle was therefore between February and March 1950. The next trough is due, ideally, between May and June of 1954.

Fig. 4 shows a synthesis of the typical 9.2- and 8.5-year cycles in comparison with the actual deviations with which we started.

The amplitude of the synthesis of the two cycles diminishes as we go from 1784 to about 1817. It then increases until about 1882. After 1882 it decreases again to a low about 1937. From 1937 forward it again increases. You will also note that the shape of the waves of the synthesis change as well as the amplitude.

When you compare the synthesis of the two cycles in Fig. 4 with the actual deviations it is clear that at least the amplitude of the deviations conforms much more closely to the synthesis of the 9.2- and 8.5-year cycles than it does to the rigid 9.2-year cycle shown in Fig. 2.

Do we have in the pig iron price deviations a 9.2-year cycle which varies progressively in amplitude, and perhaps in shape and period, which can be partially *described* in terms of a synthesis of two cycles, or do we have pig iron price behavior which was *caused* by two separate cyclic forces of 9.2 and 8.5 years in length respectively? No one knows.

Causes

At the beginning of this paper it was stated that the observed behavior could be caused (1) by random forces, (2) by internal dynamics, or (3) by some external environmental force or forces.

1. Random Forces. It is difficult for me to accept the idea of a purely random cause for this behavior.

First, although it is possible to find rhythms in random numbers, it would be most unusual for the rhythmic sequence to continue in such numbers for as many as 18 consecutive repetitions.

Second, a 9-year cycle in pig iron prices 1825-1874 (50 years), discovered in 1875,[2] has continued from 1875 to date (79 years). Such a cycle also fits pig iron prices 1784—1825 (42 years) when the data are extended backward. (With 18 cycles now available for averaging, it is clear that the length of the cycle is about 9.2 years long—slightly more than the 9 years estimated in 1875 when only five complete cycles were available for study.)

Five or six consecutive rhythmic cycles are not unusual in random numbers. However, having discovered such a cycle in a series of random numbers, it would be most unusual to find the cycle continuing in the series of random numbers when such a series is extended forward and backward.

2. Internal Dynamics. It is difficult for me to accept *internal dynamics* as the cause of the observed behavior. I can see how internal dynamics could cause rhythmic fluctuations in prices. But it seems to me that if the rhythms were caused by internal dynamics, after a major distortion such as that of the Civil War a *new* sequence of rhythms would begin. It is hard for me to see how, from internal dynamic causes alone the *old* rhythm could re-establish itself.

3. External Environmental Force. If I am right in my reasoning, an external rhythmic cause is the only possible explanation of the 9.2-year cycle. What this rhythmic force might be I have no idea.

The first step in solving the mystery would be to find environmental phenomena which fluctuate in a rhythm of this length. Then to see whether or not logical cause and effect relation ships could be extablished between the prices of pig iron and one or more of the environmental phenomena showing the same characteristics.

A Corollary

One important observation needs to be made: Unless the 18 consecutive alternations of relative strength and weakness can be ascribed to chance, we must admit that there is some causative factor or factors (internal or external, it makes no difference) having to do with pig iron price fluctuations which are not yet taken into account by present economic theorists. As one economist admitted in confidence, "If these rhythmic behaviors have any significance, all I have ever learned about economics is wrong." It is obvious that the subject is important.

---

[2] Samuel Benner, *Benners Prophecies of Future Ups and Downs of Prices,* published by the author Cincinnati, 1876. Reprinted by the Foundation for the Study of Cycles, 1947. as reprint No. 24

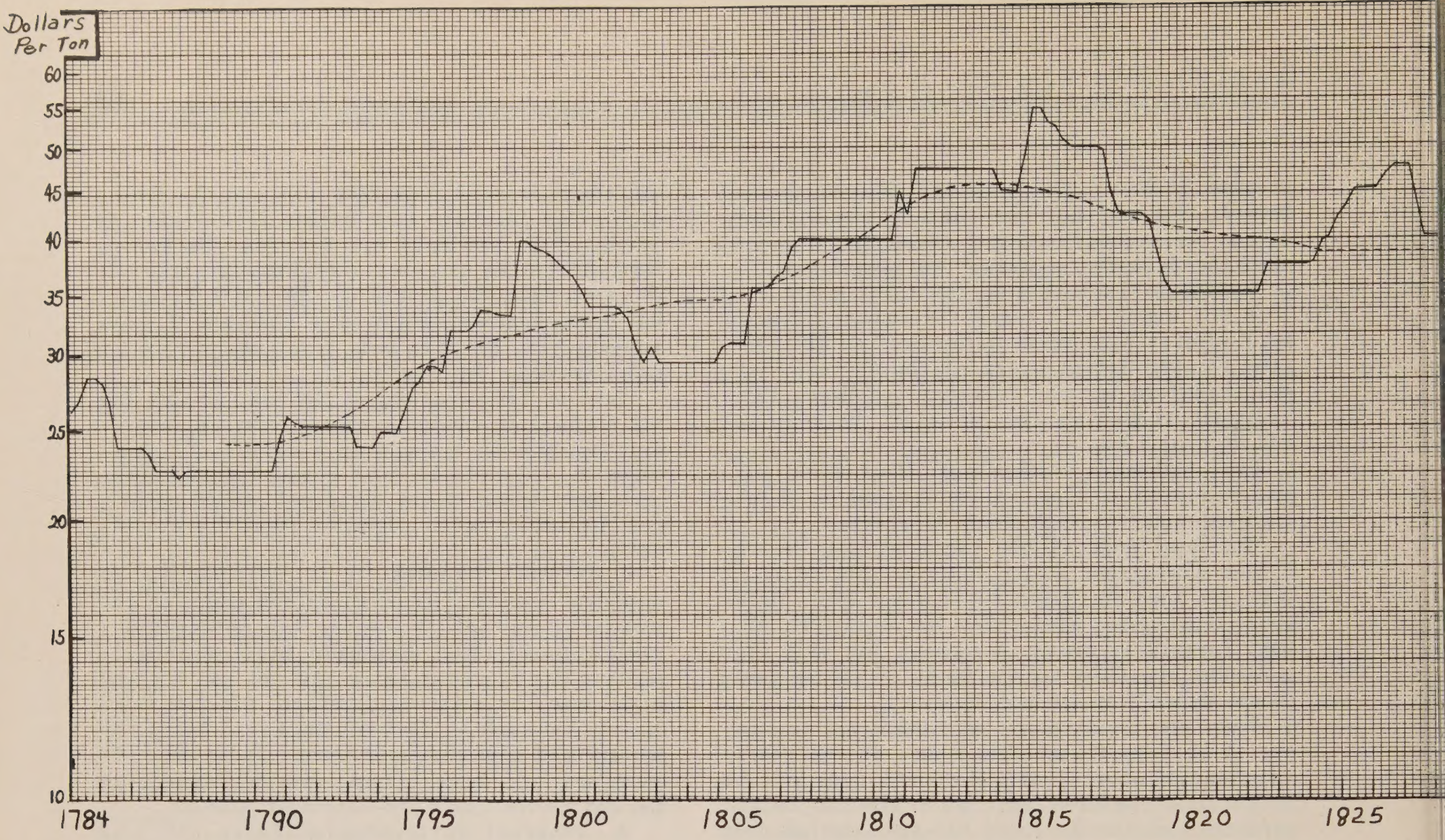


FIG. 1. PIG IRON PRICES, FIRST QUARTER 1784—FOURTH QUARTER 1953.
Solid line—actual prices. Ratio scale.
Dashed line—first quarter 1862 to fourth quarter 1878, and third quarter 1933 to date--show prices adjusted to a gold basis.
Smooth broken line—represents short term trend (41-quarter (10 1/4-year) centered moving average).

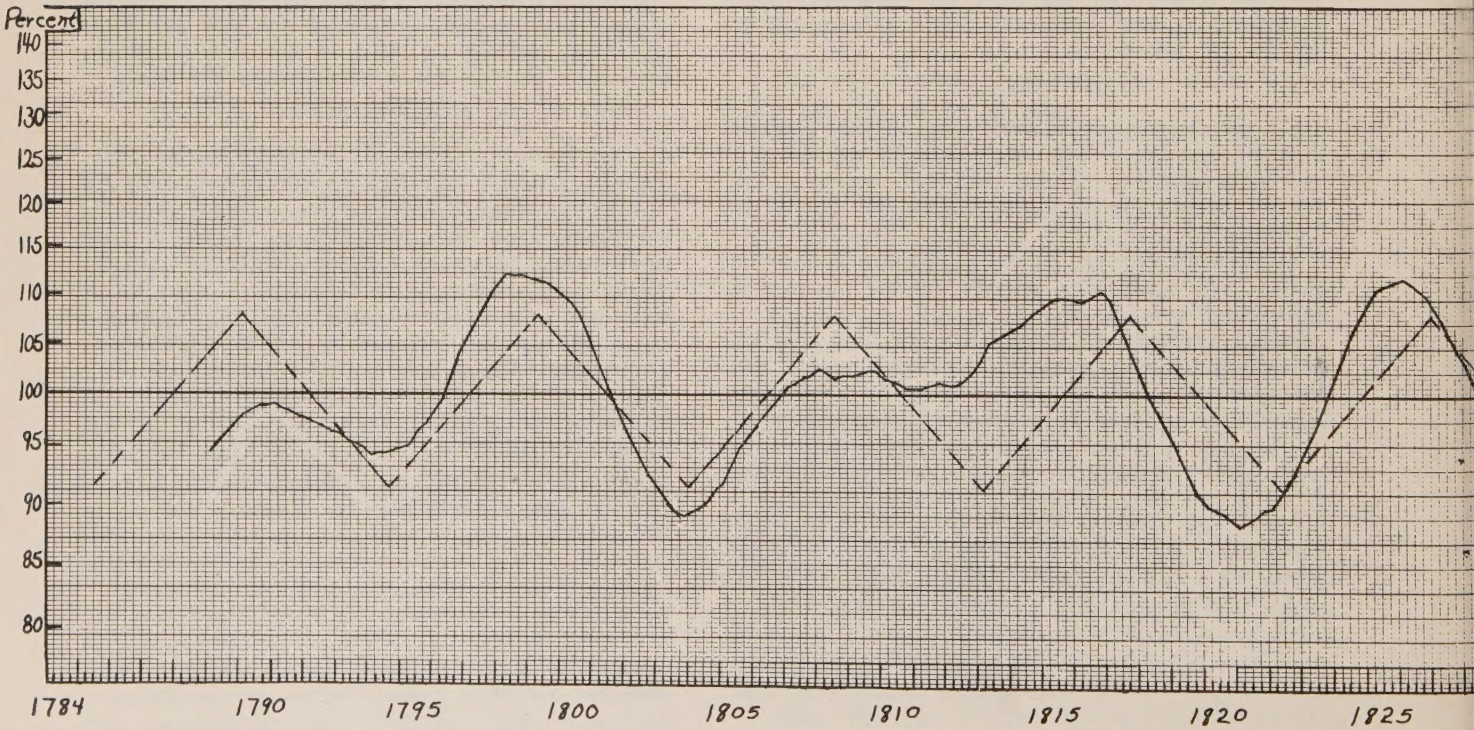


FIG. 2. THE 9.2-YEAR CYCLE IN PIG IRON PRICES, 1784—1953.
Actual prices smoothed by a 17-quarter moving average, expressed as percentages of their own 41-quarter (10 1/4-year) moving average.
The broken line diagrams the 9.2-year cycle. Ratio scale.

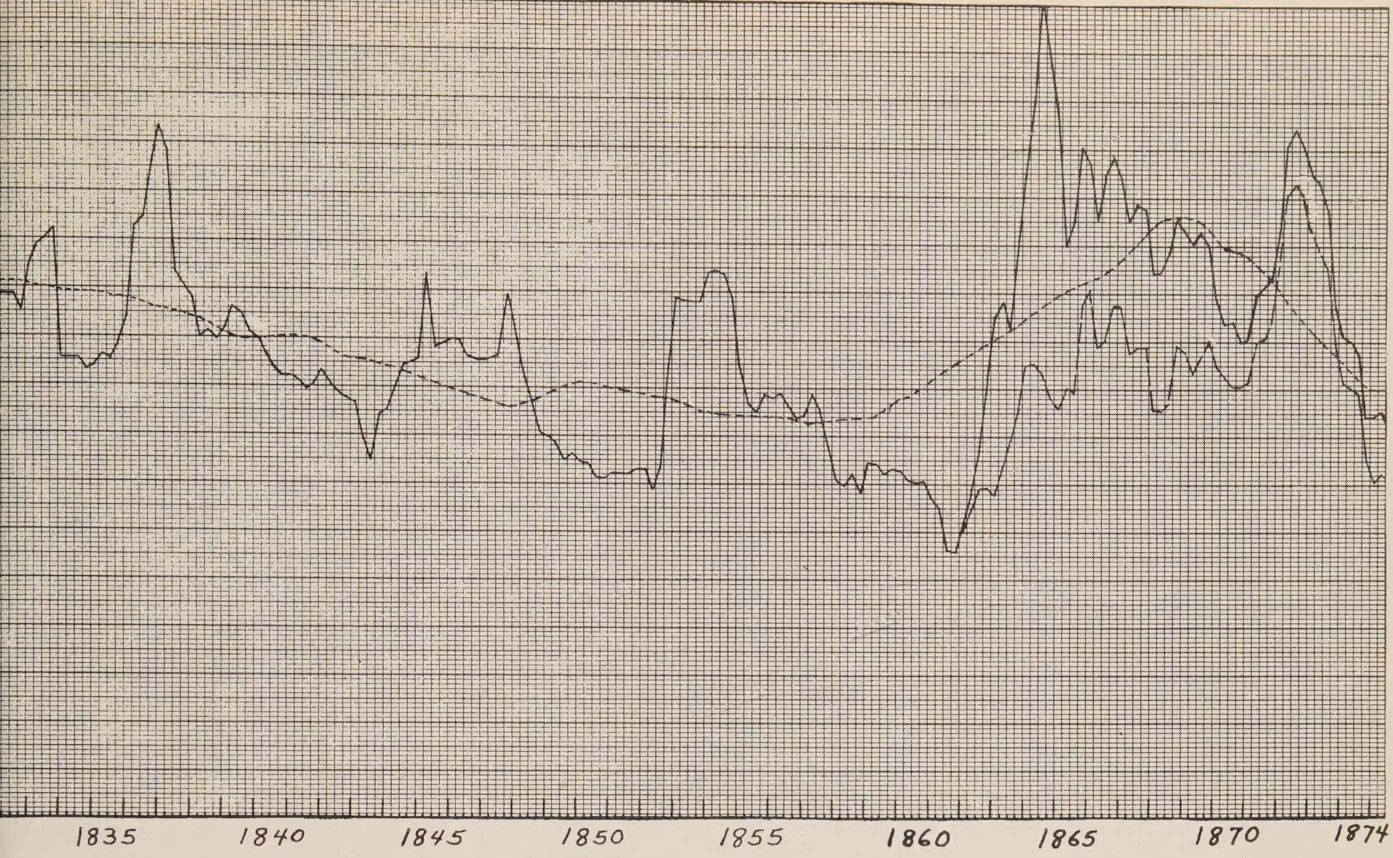


FIG. 1. (CONTINUED)

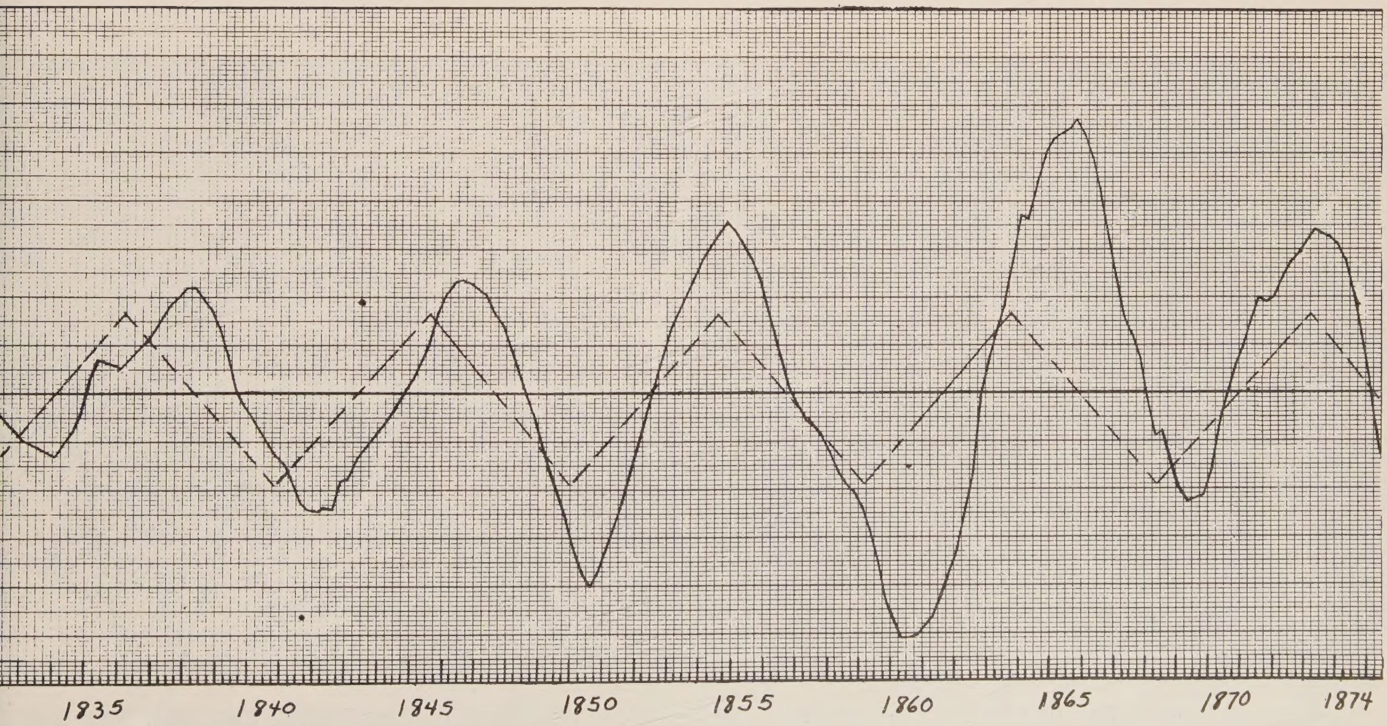


FIG. 2. (CONTINUED)

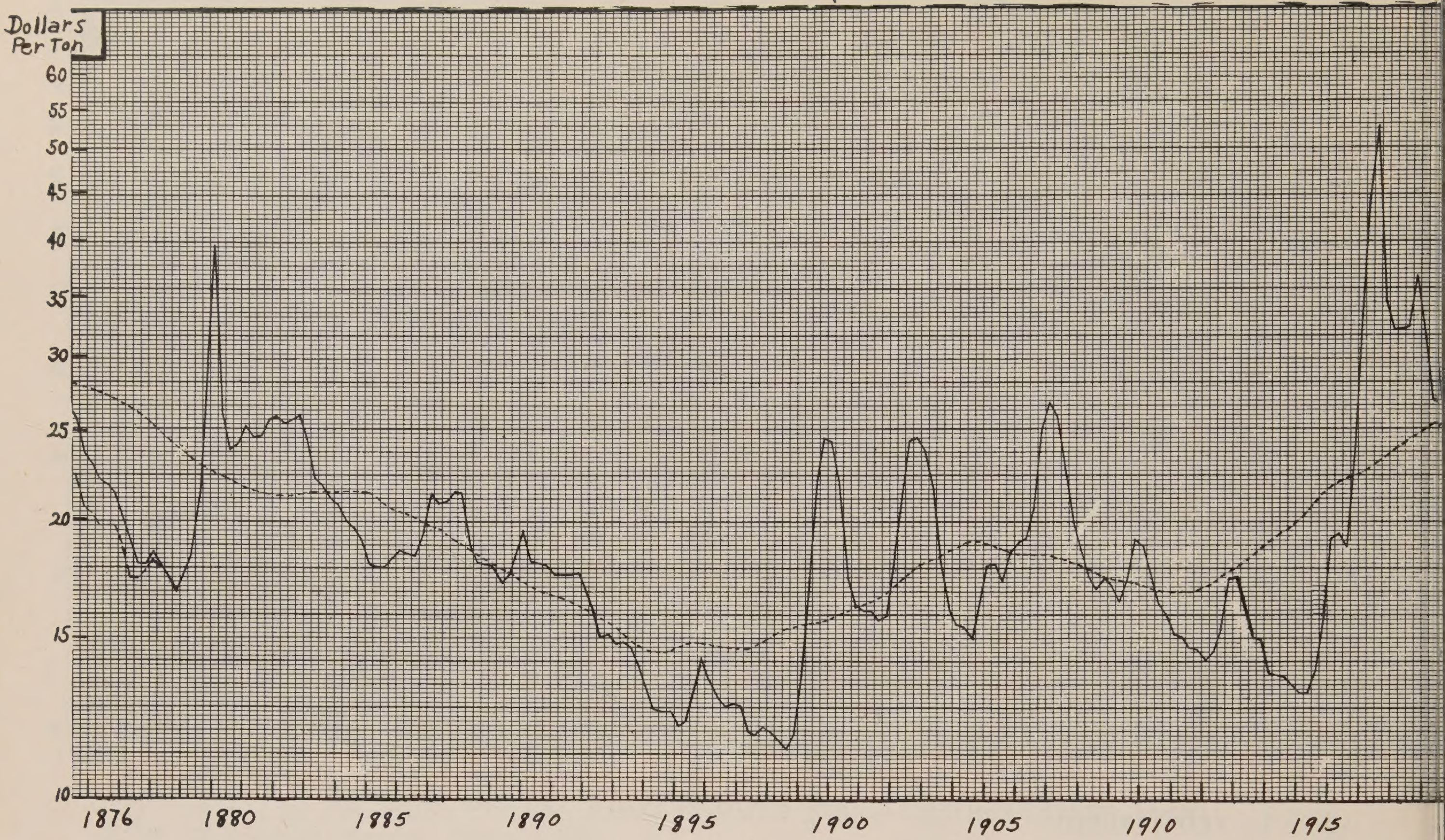


FIG. 1. (CONTINUED)

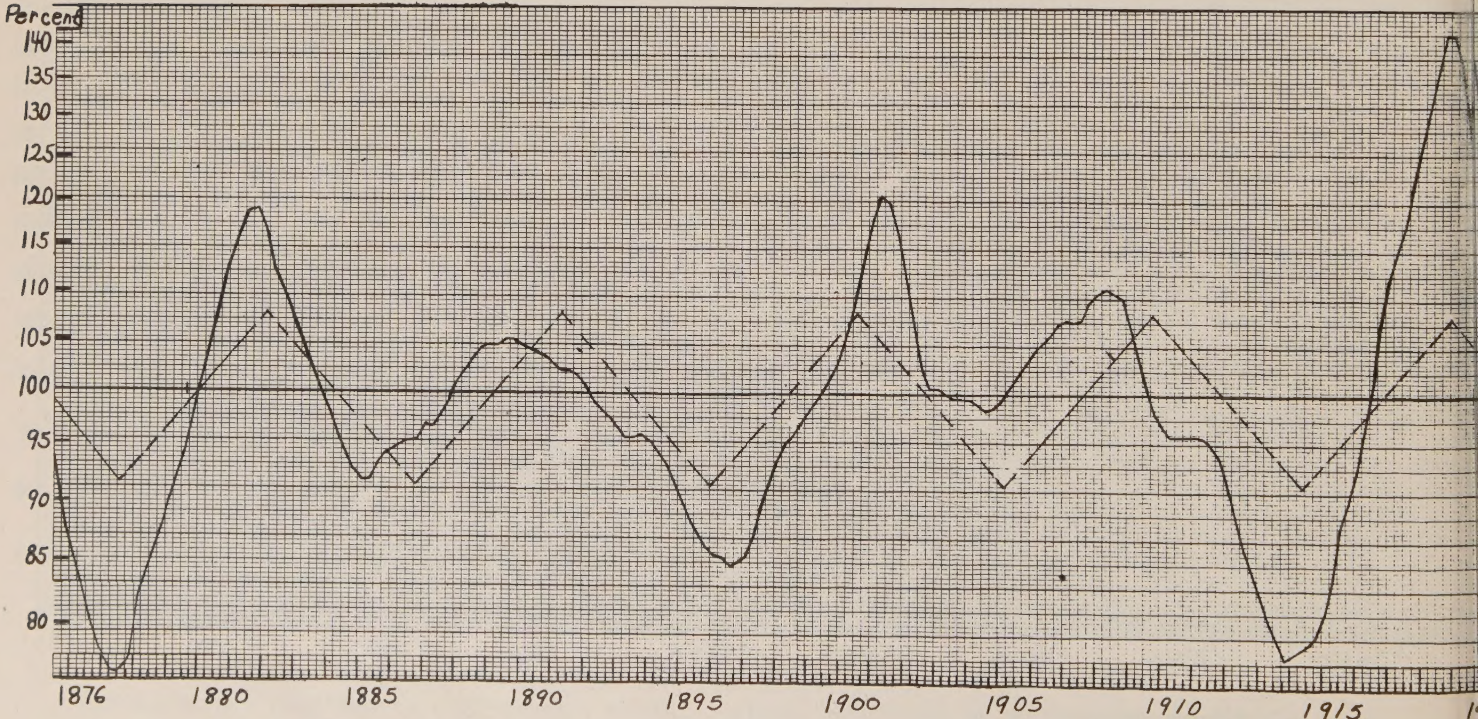


FIG. 2. (CONTINUED)

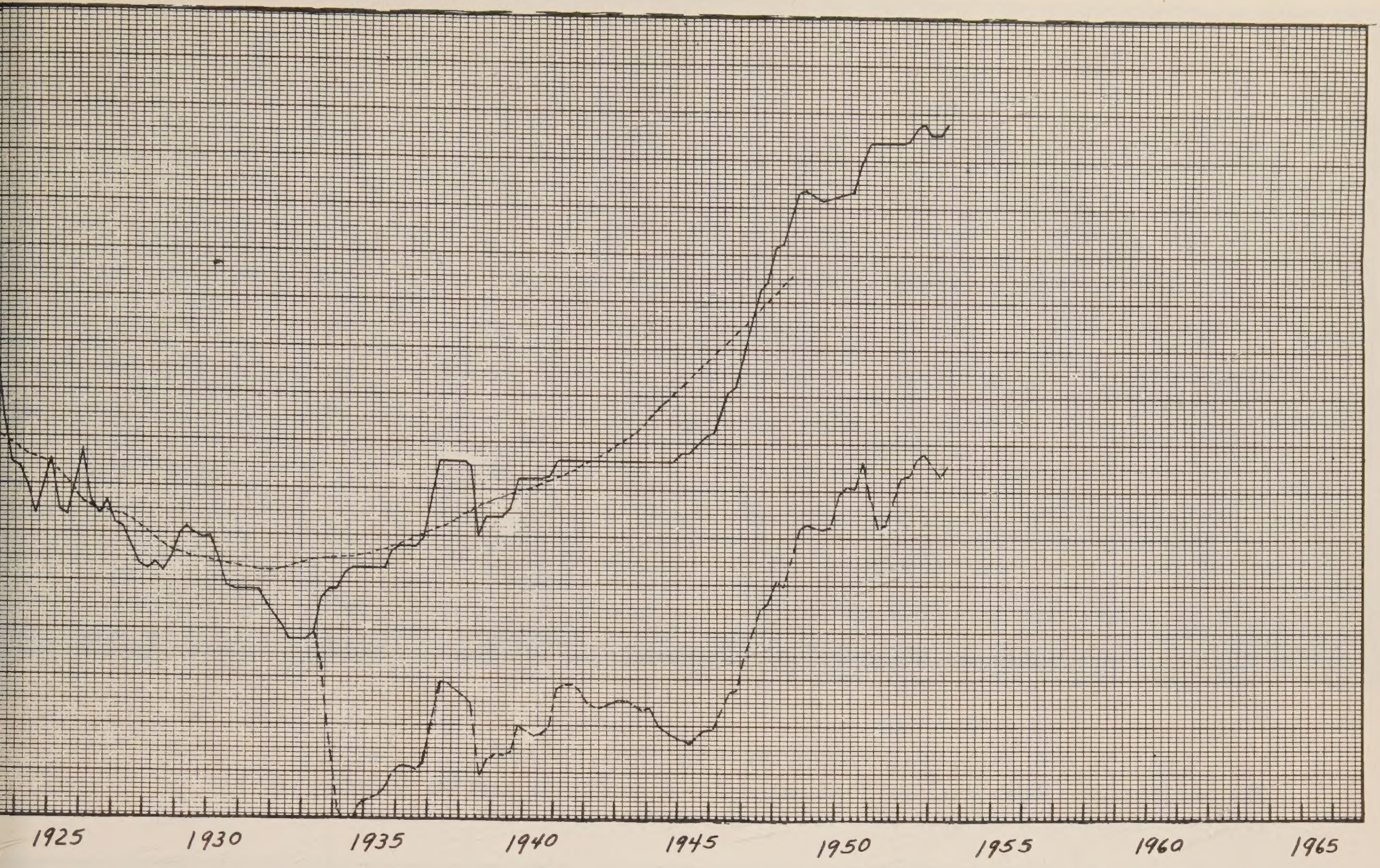


FIG. 1. (CONTINUED)

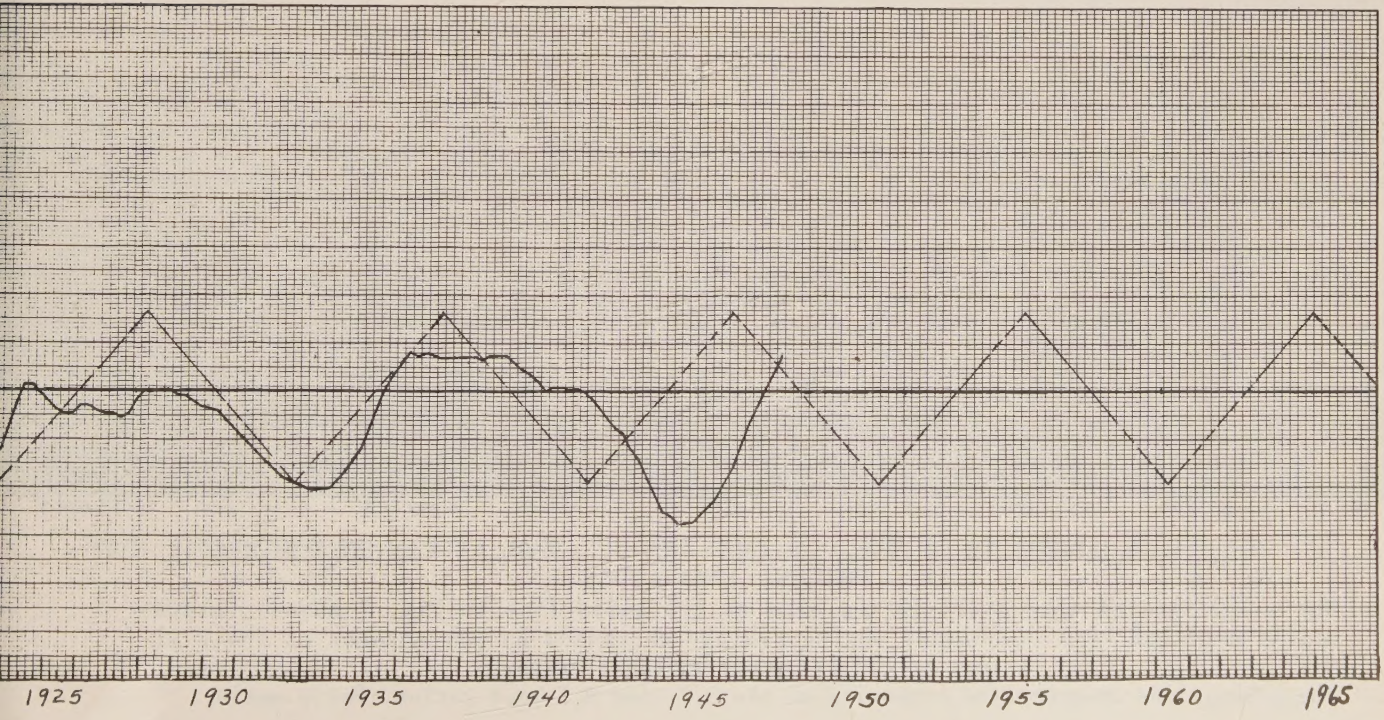


FIG. 2. (CONTINUED)

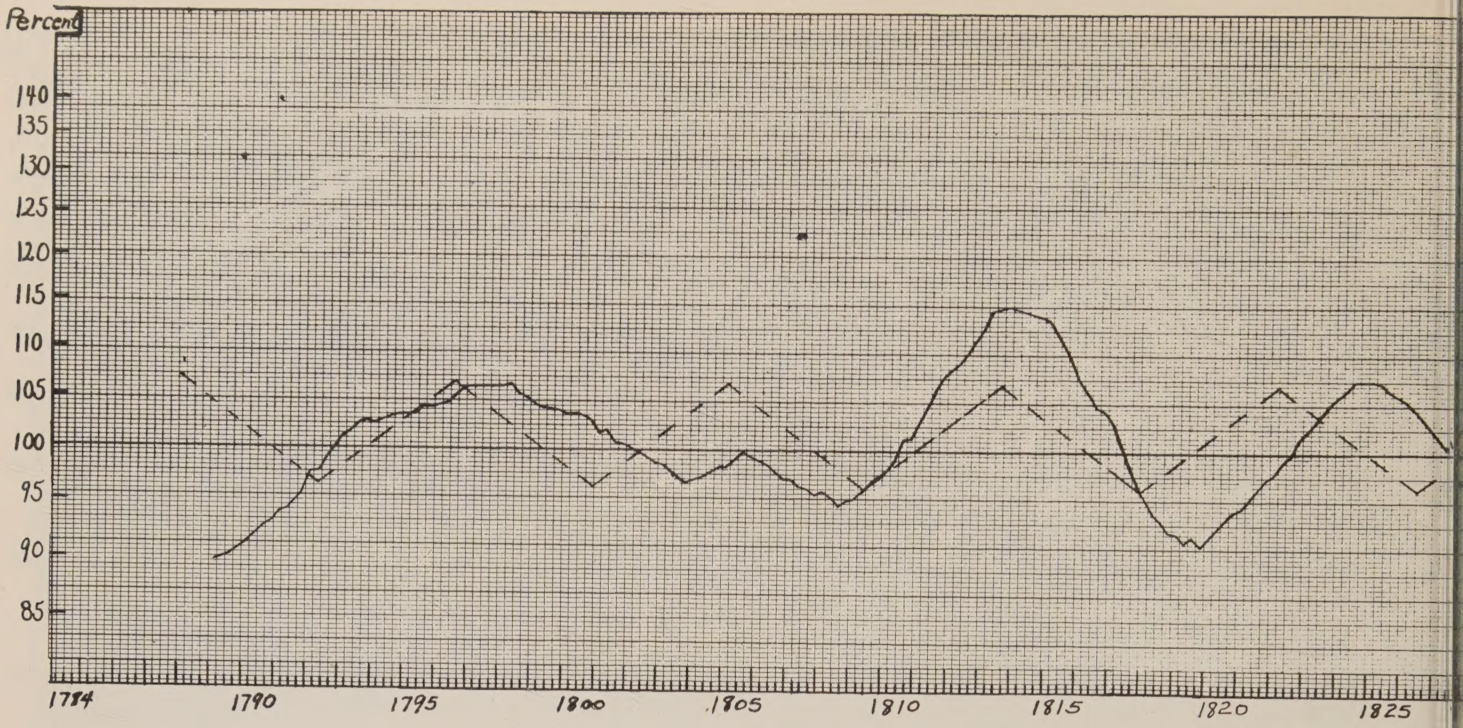


FIG. 3. THE 8.5-YEAR CYCLE IN PIG IRON PRICES, 1784—1953.
The percentages shown in Fig. 2 adjusted for a perfectly regular 9.2year cycle. Broken line shows a diagram of a perfectly regular 8.53-year cycle. Ratio scale.

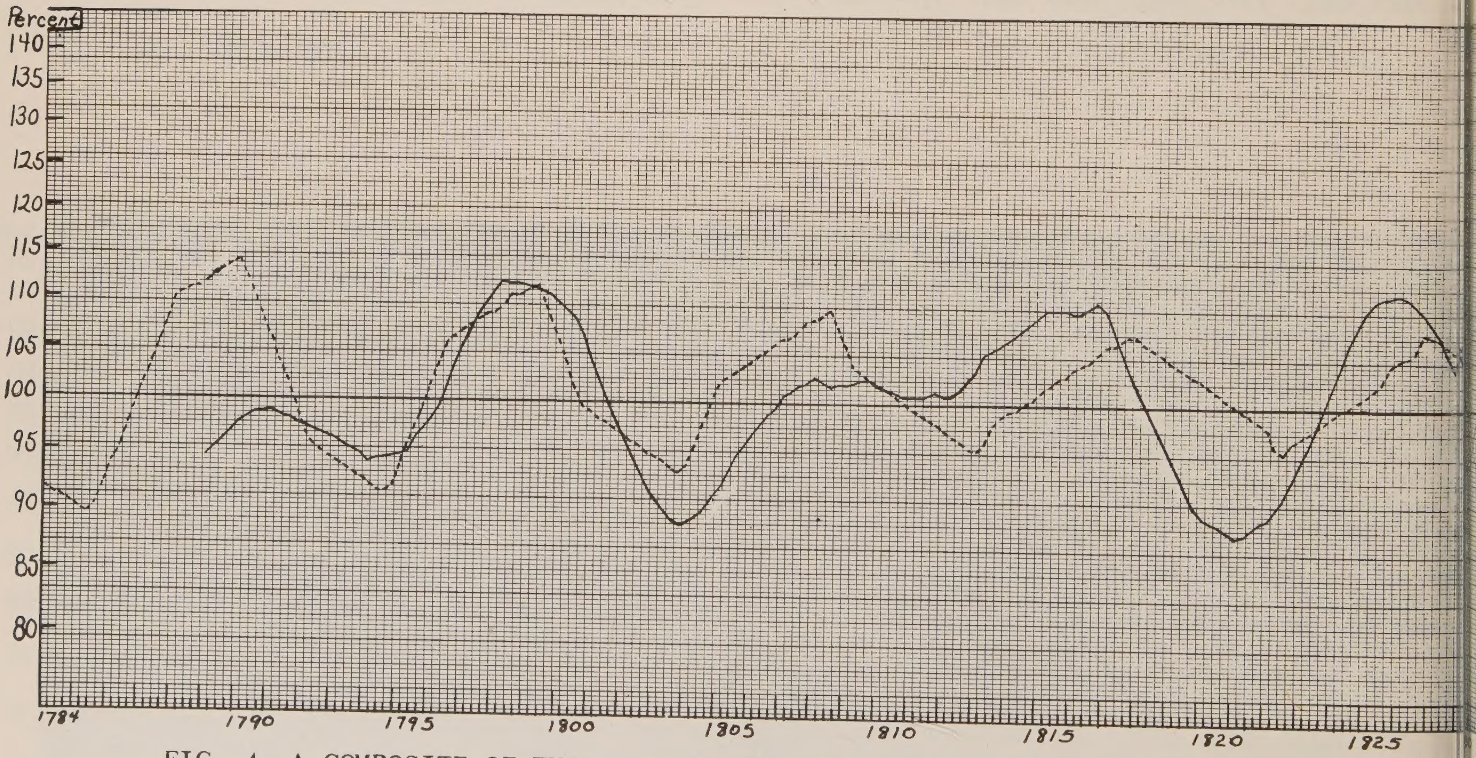


FIG. 4. A COMPOSITE OF THE 9.2- AND THE 8.5-YEAR CYCLES IN PIG IRON PRICES, 1784—1953.
The solid line on this chart is the same as the solid line in Fig. 2 namely, actual prices smoothed by a 17-quarter moving average expressed as percentages of their 41-quarter (10 1/4-year) moving average.
The broken line diagrams the composite of the 9.2- and 8.5-year cycles. Ratio scale.

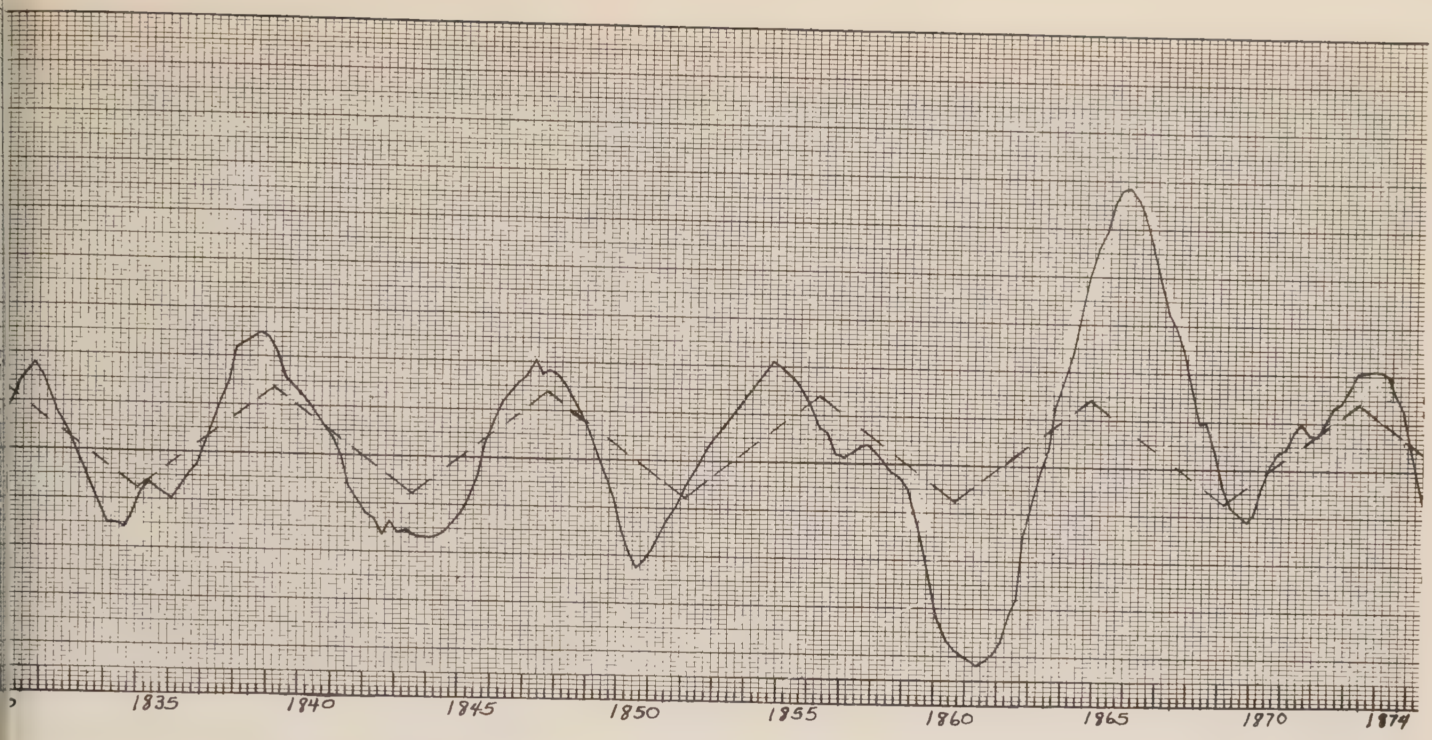


FIG. 3. (CONTINUED)

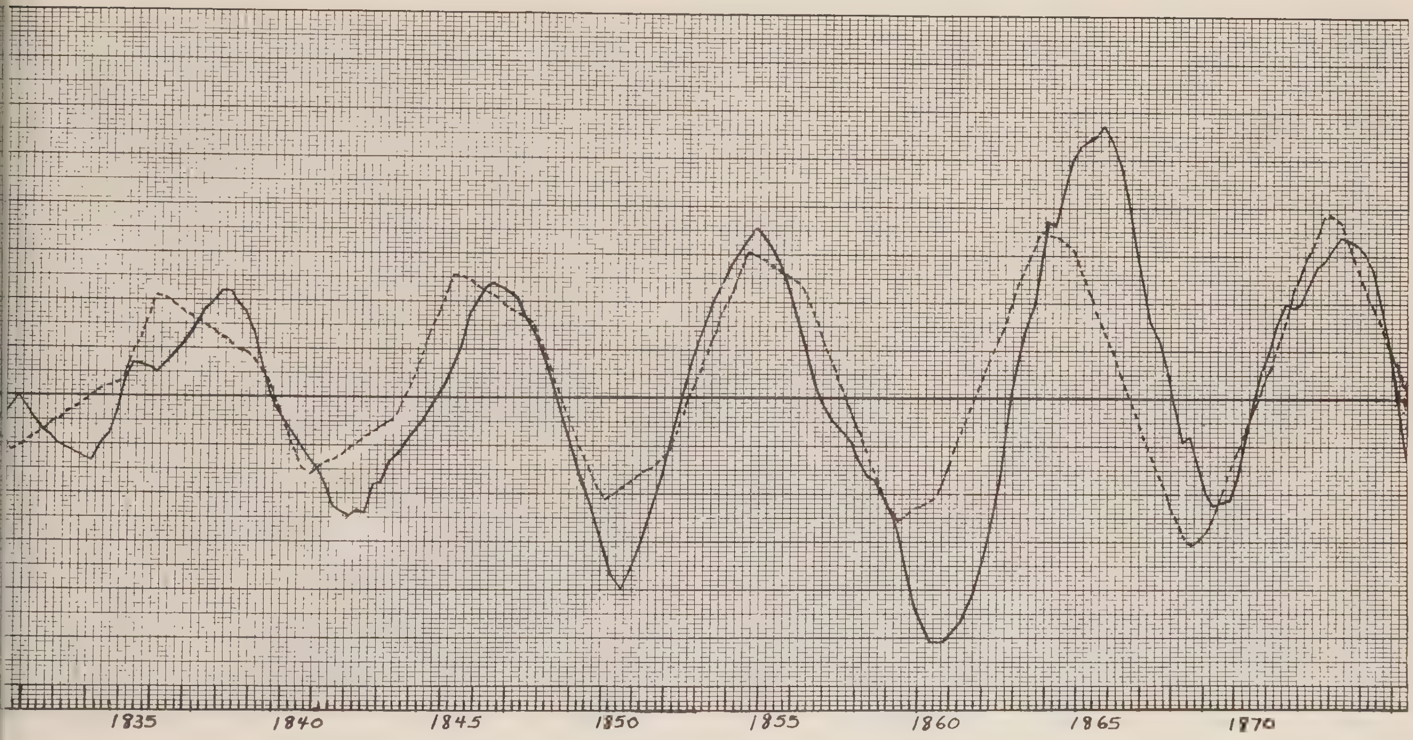


FIG. 4. (CONTINUED)

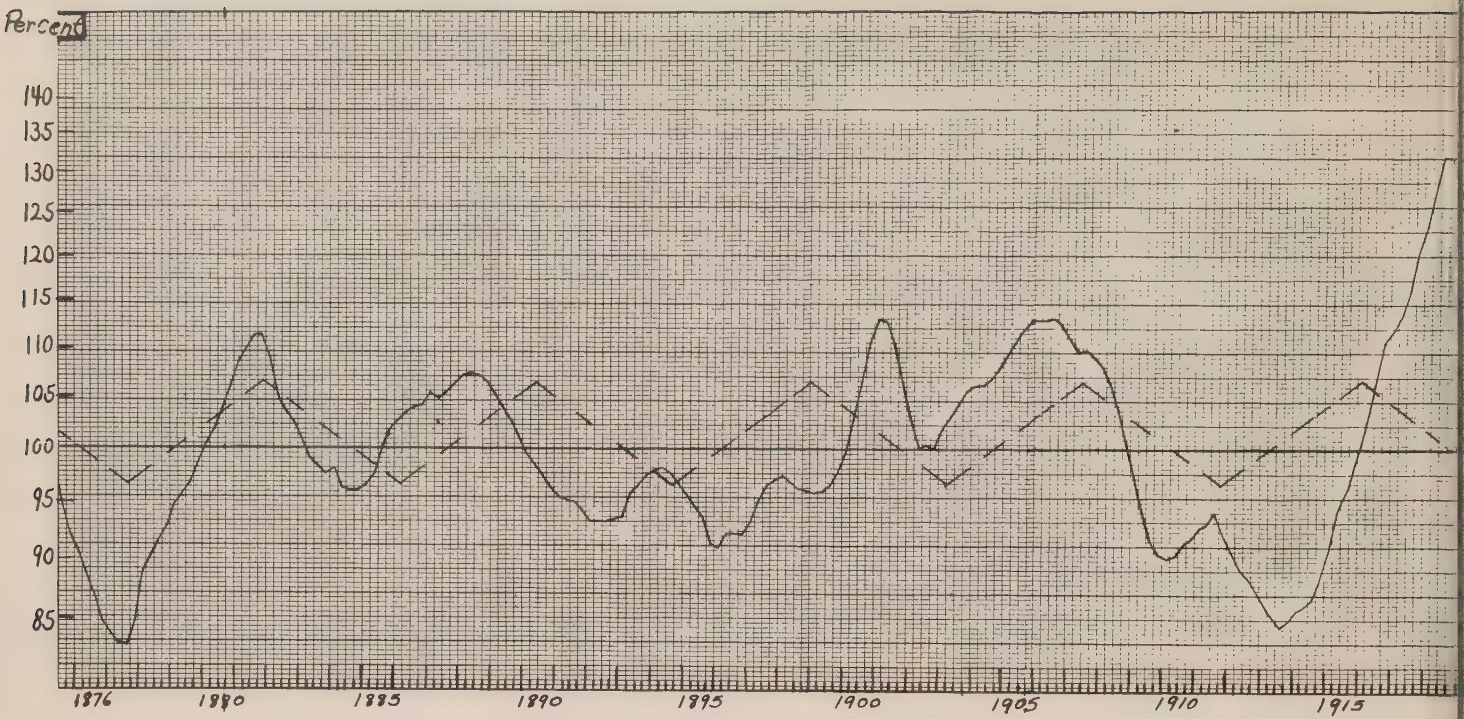


FIG. 3. (CONTINUED)

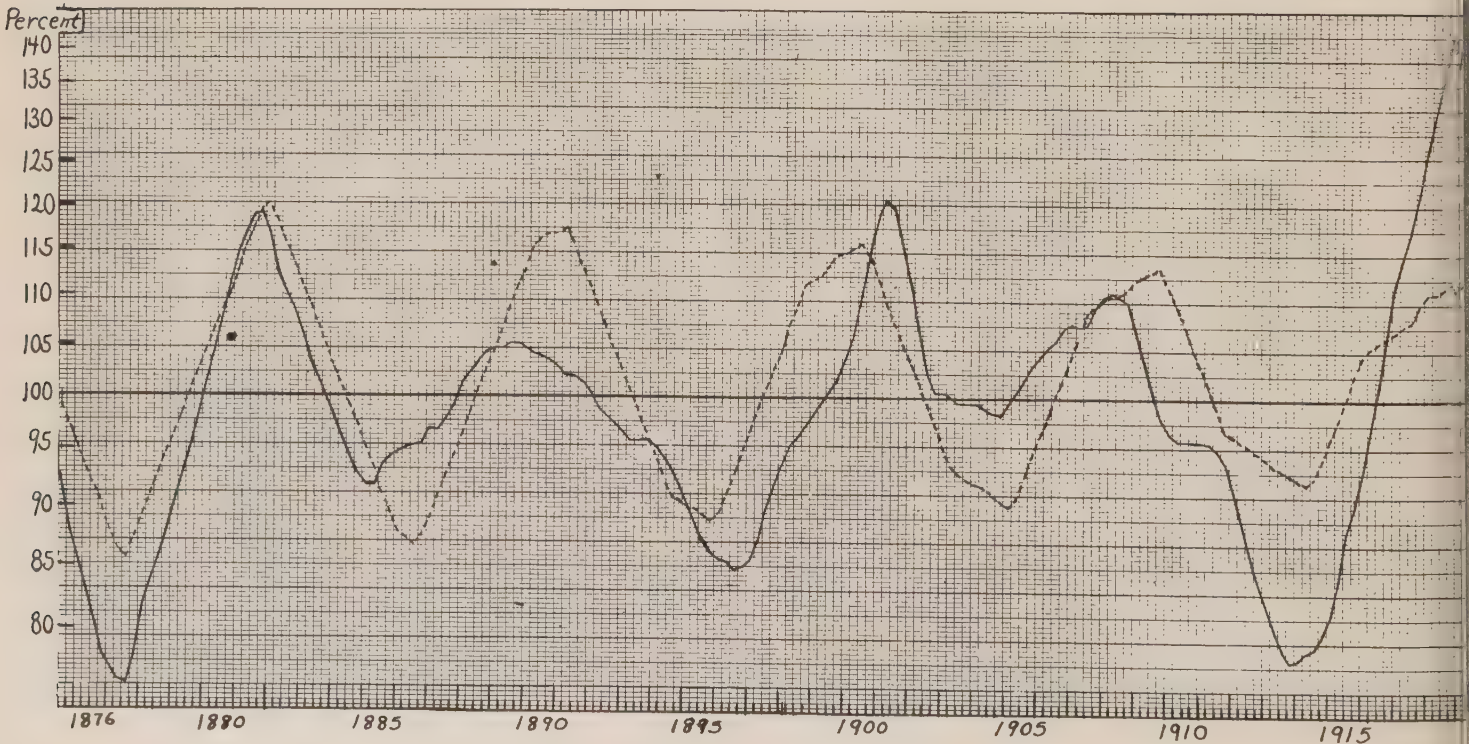


FIG. 4. (CONTINUED)

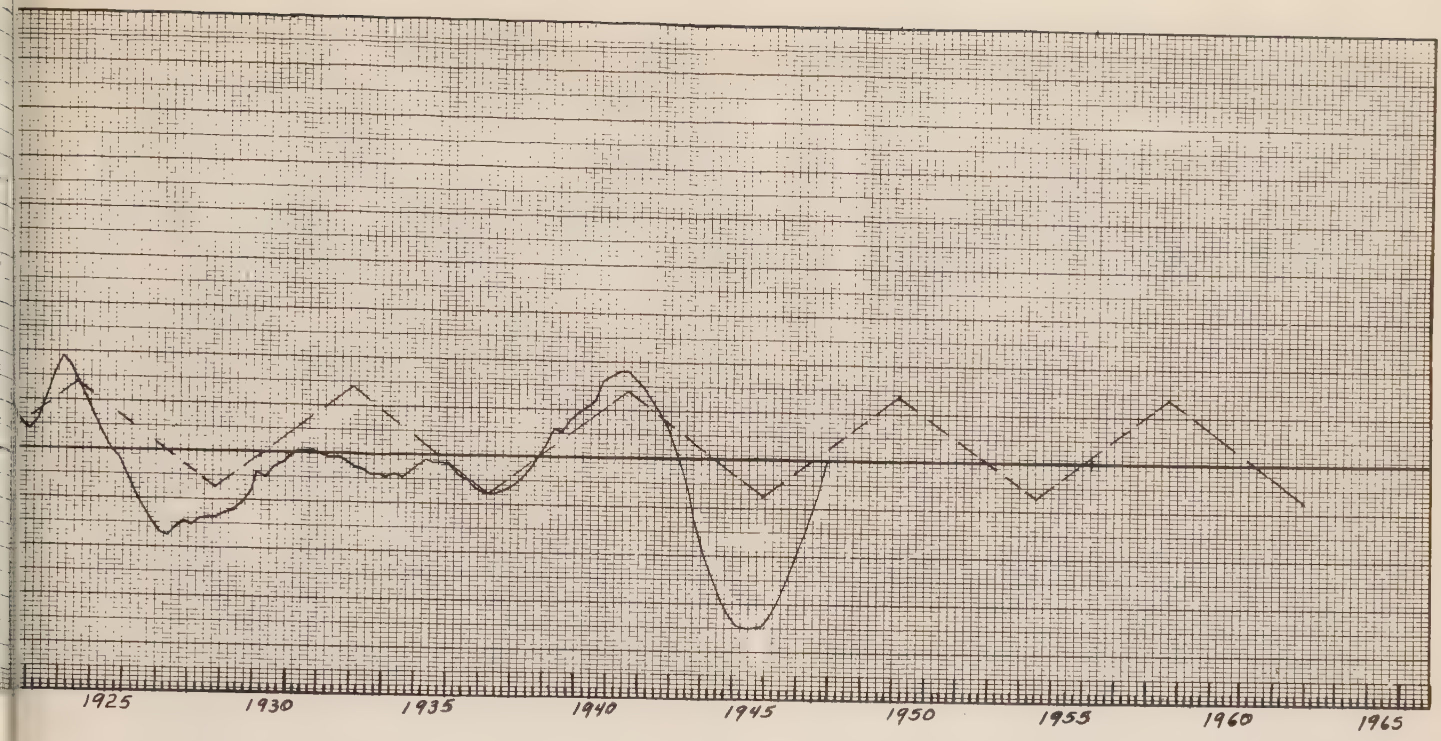


FIG. 3. (CONTINUED)

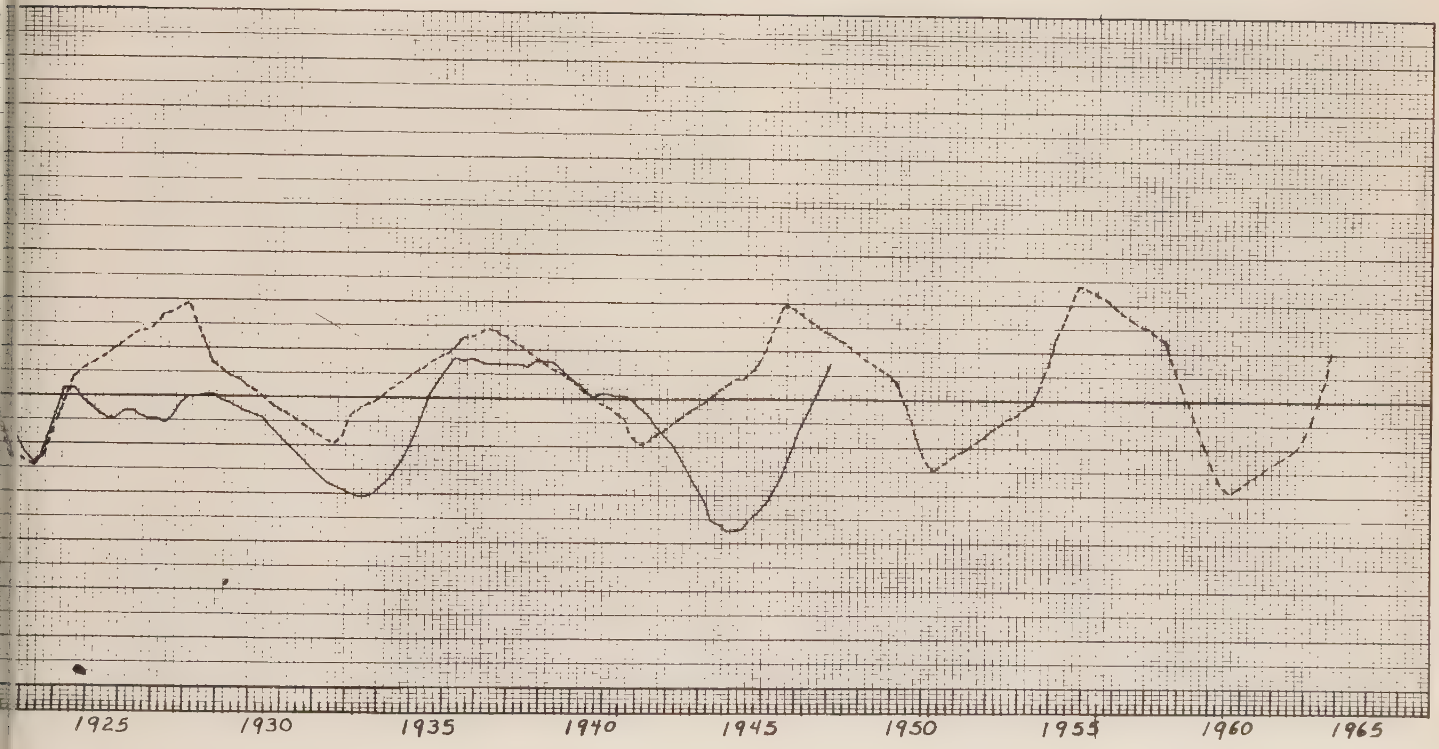


FIG. 4. (CONTINUED)

THE SUNSPOT CYCLE A.D. 301—1950

D. Justin Schove.
St. David's College

Sunspot numbers form a long and reliable series of indices and have been calculated back to A.D. 1749. The remarkable 11-year cycle is obvious but it is quite unexplained.

Harmonic analysis has been used in an attempt to extend the series into the future, but the results are unsatisfactory. It seems that there is only the one cycle, but the distance between two maxima varies in an irregular manner from 9 to 16 years. It has been suggested that in some centuries a shorter 10-year cycle replaces the normal one (Zeuner, 1952). However that may be, it is difficult to be precise about the length of the *mean* cycle, sometimes regarded as 10.9 and sometimes as much as 11.4 years.

The vagueness in the length of the cycle makes precise prediction very difficult. The last great sunspot maximum was expected by some scientists as late as 1949, eleven years after the great sunspot year of 1938, but it actually came in 1947 (Schove, 1947, p. 233). Since 1947 I have received various reprints on the topic, including papers by Cook (1949), Gleissberg (1949, 1951), McNish and Lincoln (1947) that show how sunspot numbers are being predicted from month to month and year to year. Predictions extending to the next cycle are still rather speculative. Cook has shown that an intense maximum (such as that of 1947) is usually early and followed by a slow long decline to a late minimum. Gleissberg in 1951 suggested a minimum between March and July 1955 and an intense maximum between August 1958 and 1959.

The test of all formulae and theories of the sunspot cycle must ultimately lie in prediction, but a single cycle such as 1959 would not be decisive, and prediction of past maxima would be more impressive. It is now possible to determine the approximate year of every sunspot cycle since A.D. 300—in all about 150 cycles (Schove 1948a, 1950/51 and 1951).

There are various records of ancient sunspots and of ancient displays of the aurora (Schove 1951 and 1951/2) in different parts of the world. These have been accumulated initially as by-products of a collection of meteorological chronologies sent to me from different parts of the world in connection with the so-called Spectrum of Time project.

A preliminary attempt to determine the early years of maxima was made in the nineteenth century by Wolf and Fritz, whose results are generally quoted. Their analysis was, however, somewhat uncritical, and it was fitted somewhat arbitrarily into an 11-year scheme. As evidence they used

(a) Sunspots
(b) Aurorae
(c) Hail in Central Europe
and (d) Wine harvests in Central Europe.

It so happened that in the 1870's the rather shorter trade cycle and the sunspot cycle were almost in phase, and even scientists were ready to believe in close associations between hail, harvest-failures and sunspot maxima.* It is now clear that no valid conclusions about sunspot cycles can be gleaned from references to hailstorms and wine-harvests.

In view of rather shaky foundations of these methods, it is proposed to prepare a table from the evidence of (a) Sunspots and (b) Aurorae only. In two stimulating books, Stetson** has claimed that the sunspot cycle can be detected in many terrestrial affairs, but his correlations do not seem to apply historically. The results of (e) tree-ring analysis (de Boer, 1951-2) and (f) earthquakes (Davison, 1938) are being used in the attempt to determine early sunspot cycles, it should be possible to check the validity of this procedure by independent means. Information on these topics and in fact on all early meteorological (g) and astronomical (h) observations is being assembled so that full investigations can later be made.

A preliminary investigation of any supposed

---

*See Brooks, 1934, for an investigation of global relationships between sunspots and thunderstorms.

**Sunspots and their Effects 1937 New York: Sunspots in Action 1947 New York relationship with the sunspot cycle can be made by the phase-method now to be described. This is based on the fact that there are nearly always exactly nine sunspot cycles in a century, and the phase of the cycle in a particular century can be precisely defined. The last two digits of the year of an observation or index number are divided by 11 and the remainder is then regarded as a measure of the phase. It is perhaps wiser at present to avoid the exact term phase and to speak of Schove remainders' until a more precise formula is available. The application of this idea to the sunspot numbers of the nineteenth century is illustrated in Table 1.

There is clearly a tendency for sunspots to occur in the nineteenth century in years which give Schove-remainders of 4 or 5. Graphical interpolation suggest 4 1/3 as the mean "remainder" of the century. Century mean remainders can be determined for earlier centuries not from sunspot-numbers in the modern sense but from numbers of records of sunspots and aurorae.*

The sunspot cycle differs little from 11.1 or 100 divided by 9. Hence it follows that sunspot maxima and minima tend to occur in the corresponding years of each century. Thus maxima occur in 16*39*, 17*38*, 18*37*, and 19*37*, whilst minima occur in 16*10*, 17*12*, 18*10*, and 19*13*. The last two digits of minimum-years tend to be exactly divisible by 11. Examples are 16*55*, 16*66*, 17*55*, 18*33* and 19*33*. From a preliminary survey it appeared that this pattern was true of most centuries since the 9th century A.D. In other words the "remainder" of subsequent centuries has usually been 4 or 5. The centuries from the fourth to the eighth behaved in the opposite way. Years whose last two digits are exactly divisible by 11 (e.g. 311, 577) are approximately years of sunspot maximum. The "remainder" of these centuries is approximately zero.

The same general impression is given if instead we use the data of Fritz or the maxima of Nicolini (1942) who utilized some of the material from the Far East.

Some preliminary results of the new analysis have been published (Schove 1950/56) and it is possible to present a list of maxima from A.D. 400 to 650 as follows (Schove 1950/1, see p. 127):

A.D.	Remainder	A.D.	Remainder	A.D.	Remainder
430	--3 or +8	500	+½	555	+0
441	-3 or +8	511	+0	566	+0
479	+2	522	+0	577	+0
490	+2	532	-1	643	-1

Many attempts, notably by Chizhevsky, have been made to connect human affairs with the sunspot cycle. It is sometimes possible to claim an 11-year cycle in perhaps medieval recurrences of the plague—in ancient tree-rings—or in outbreaks of revolutions. There is in fact a curious coincidence between revolutions and sunspots. 1789, 1830, 1848, 1905, and 1917 were all near sunspot maxima.

The discovery of an 11-year cycle in any series of records is not enough to indicate a connection with the sunspot cycle. It is necessary to determine for each century the "remainder" by the method indicated above. It is permissible also to form five-year overlapping means of the results for each specified remainder, as indicated in the bottom row of the table. An attempt was made to apply this method to Scandinavian tree-ring data (See Schove 1950a). The 11-year cycle which is supposed to exist in the ring-widths did not seem to be related to the sunspot cycle because the phase varied from century to century. Better results may be obtained from trees in equatorial regions now being investigated by de Boer (1951/2). The writer would be very pleased to hear of any results—whether negative or positive—obtained by the application of the methods outlined above.

---

*STRICTLY THE AURORAL MAXIMA ARE SLIGHTLY LATER THAN THE MAXIMA OF THE TRUE SUNSPOT CYCLE. C.F. HARANG (1951).

TABLE I.

Sunspot Numbers of the Nineteenth Century Arranged to Illustrate the Method of Remainders

Schove Remainder	1	2	3	4	5	6	7	8	9	10	11/0
1801/11	34	45	43	47	42	28	10	8	3	0	1
12/22	5	12	14	35	46	41	30	24	16	7	4
23/33	2	9	17	36	50	63	67	71	48	27	9
34/44	13	57	121	138	103	86	63	37	24	11	15
45/55	40	61	99	124	96	67	65	54	39	21	7
56/66	4	23	55	94	96	77	59	44	47	31	16
67/77	7	37	74	139	111	102	66	45	17	11	12
78/88	3	6	32	54	60	64	63	52	25	13	7
89/99	6	7	36	73	85	78	64	42	26	27	12
1900	9										
Mean	12	29	55	82	77	67	54	42	27	16	9
Smoothed Mean	24	37	51	62	67	64	53	41	30	21	19

TABLE II.

Table of Years of Maxima of Sunspots and (or) Aurorae.
Remainders before 800 are shown on a scale from -5 to 5. Remainders after 800 are shown on a scale from 0 to 11.

YEAR	PROBABLE ERROR	REMAINDER	YEAR	PROBABLE ERROR	REMAINDER	YEAR	PROBABLE ERROR	REMAINDER	YEAR	PROBABLE ERROR	REMAINDER
301	1	-1	796	2	-3	1187	1	10	1639	2	6
312	1	-1	807	1	-7	1203	1	3	1649	2	5
322	1	0	827	1	-5	1227	1	5	1660	2	5
342	2	-2	839	2	-6	1277	2	11	1676	2	10
388	1	0	847	2	-3	1288	2	11	1684	2	7
398	1	-1	859	2	-4	1308	2	8	1692	2	4
430	1	-3	870	2	-4	1316	2	5	1706	1	6
441	1	-3	881	1	-4	1324	2	2	1718		7
479	1	-2	890	1	-2	1356	2	1	1727		5
490	1	-1	906	2	-6	1371	1	5	1738		5
500	1	0	919	2	-8	1380	1	2	1750		6
511	1	0	928	2	-6	1391	2	3	1761		7
522	1	0	939	2	-6	1401	1	1	1769		3
532	1	-1	947	3	-3	1411	3	11	1778		1
555	1	0	957	3	-2	1487	3	10	1788		0
566	1	-2	968	2	-2	1500	3	11	1804		4
577	1	-2	978	2	-1	1511	3	11	1816		5
643	2	-1	992	2	-4	1519	3	8	1829		7
655	1	0	1002	2	-2	1529	2	7	1837		4
664	1	-2	1017	2	-5	1538	2	5	1848		4
675	2	-2	1029	3	-7	1548	2	4	1860		5
714	1	-3	1088	2	-11	1560	2	5	1870		4
726	1	-4	1098	2	-10	1572	3	5	1883		6
735	2	-2	1116	2	5	1582	3	5	1894		6
746	3	-2	1130	2	8	1590	2	2	1907		7
763	1	-3	1138	1	5	1602	2	2	1917		6
775	2	-2	1151	2	6	1618	2	7	1928		6
785	1	-3	1177	1	11	1627	2	5	1937		5
									1947?		3?

N. B. The above table is based on a survey of information received up to 1949, and it will be subject to numerous small alterations as the evidence for each cycle is assembled and assessed separately. Sunspots and aurorae will have to be separated, as the cycles do not exactly coincide. See: L. Harang The Aurora c. 1951 (Chapman & Hall, London).

Bibliography

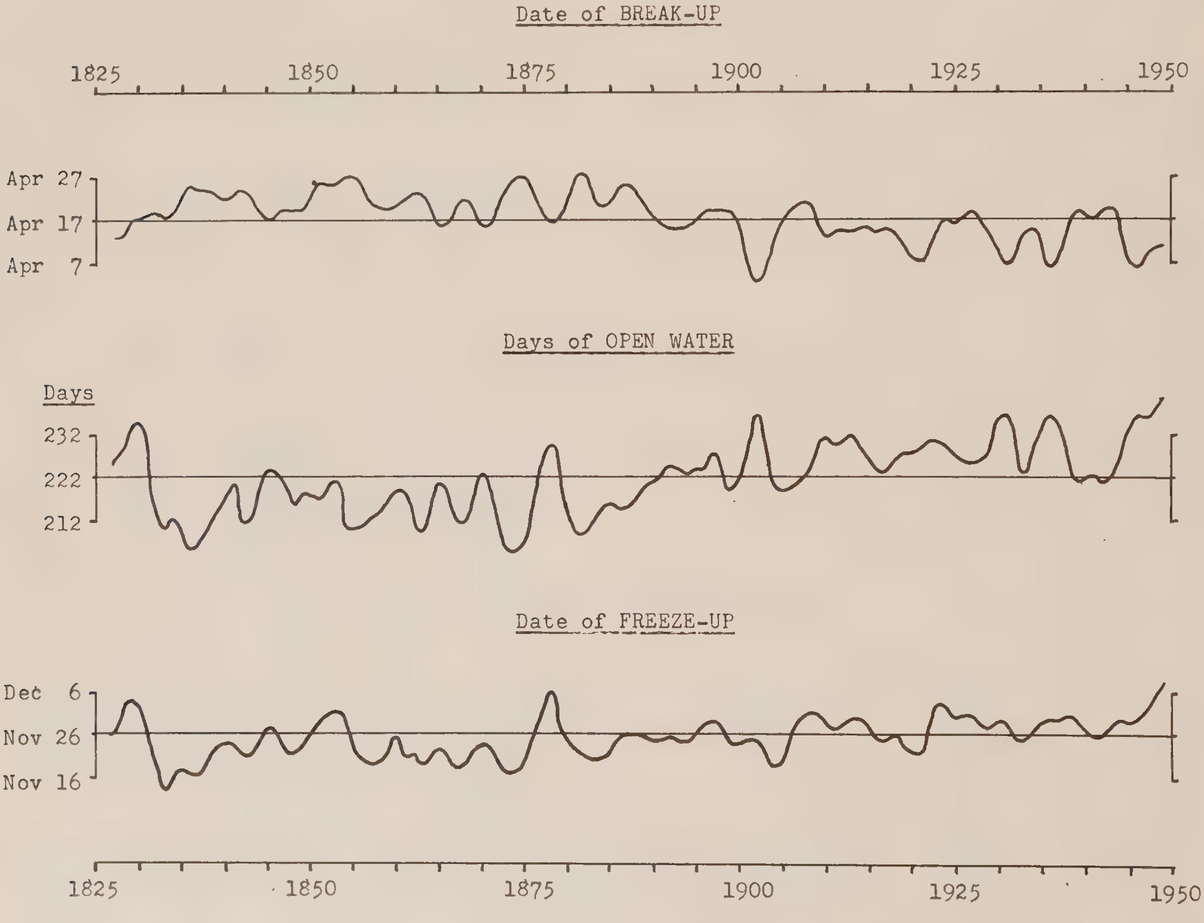
de Boer, H.J.,	1951-2	Tree-ring measurements and weather fluctuations in Java from A.D. 1514 *Kon. Ned. Akad. van Weten.* Ser B. 54 No. 3 and 55 No. 4, 386-394
Brooks, C.E.P.,	1934,	Quart. Journ. Roy.Met.Soc., London, *60,* 153 - 165
Cook, A.F.,	1949,	*Jnl. Geophys. Res. 54,* No. 4, 347 - 353 "On the Mathematical Characteristics of Sunspot-Variations."
Davison, C.	1938,	Studies in the periodicity of earthquakes, London.
Gleissberg, W.,	1949,	*Astrophysical Jnl 109* 321 - 326. "The Predictability of the Probable Features of the Sunspot Cycles."
	1951,	*Zeit fur Astrophysik, 29,* 1 - 8
Harang, L.,	1951,	"The Aurora" (Chapman & Hall) London.
McNish, A.G. and Lincoln, J.V.,	1947,	Prediction of Annual Sunspot Numbers. *U.S. Dept. Comm. National Bureau of Standards* C.R.P.L. - 1 - 1.
Nicolini, T.,	1942,	*R. Osserv. Astro. di Capodimonte* (Napoli) *Contributi Astronomici* Ser. II, Vol. II, N.7, 79-88.
Schove, D.J.,	1947,	The Sunspot Cycle before 1750 *Terr. Mag 52,* 233 - 237.
	1948a,	Sunspots and Aurorae (500 - 250 B.C.) *Joun. Brit. Astr. Assn,* London, *58,* 178 - 190 and 202 - 204
	1948b,	Sunspot Epochs A.D. 188 - 1610 *Popular Astronomy,* Northfield, Minn. U.S.A. *56,* 247 - 252
	1950a,	Tree-Rings and Summer Temperatures. A.D. 1501 - 1930 *Scott. Geog. Mag.,* Edinburgh *66,* 1950, 37 - 42.
	1950b,	Visions in North West Europe (A.D. 400-600) and Dated Auroral Displays. *Jnl. Brit. Archaeol. Assn,* 3rd Ser., *13,* 34 - 49.
	1950-1	The Earliest Dated Sunspot. *J. Brit. Astr. Assn, 61,* 22 - 25.
	1951,	Sunspots, Aurorae and Blood Rain: The Spectrum of Time. *Isis,* U.S.A. *42,* 133-138 and 126-128
	1951-2	English Aurorae 1660/1661. *J. Brit. Astr. Assn, 62,* 38 - 43 and 63 - 66
Zeuner, F.E.,	1952,	Dating the Past, 3rd Ed., London.

DATES OF BREAK-UP AND FREEZE-UP OF THE ST. JOHN RIVER AT FREDERICTON, N. B.

Bruce S. Wright
University of New Brunswick—Fredericton, New Brunswick

The dates of the break-up and freeze-up of the river at Fredericton, New Brunswick, have been recorded in the City Engineer's office since 1825. Records of this length are rare, and they have value to the student of cycles and weather phenomena. These data are therefore presented as an addition to the available published records.

The smoothed curves plotted about the average dates of break-up and freeze-up show the trend toward longer periods of open water that has taken place in the last 50 years. In the 125-year period 1825-1950 the average date of break-up was April 17, but from the beginning of the record in 1825 to about 1900 break-up occurred consistently later than this average. Between 1900-1950 it occurred consistently earlier than the average. The same trend is apparent in the date of freeze-up, so that the period of open water now averages about 10 days longer than it did prior to 1900. This is further evidence of the general trend toward warmer weather in the northeast costal region.



Date of BREAK-UP

Days of OPEN WATER

Date of FREEZE-UP

ST. JOHN RIVER at Fredericton, N.B.

Year	Thawing Date	Freezing Date	Days Open	Year	Thawing Date	Freezing Date	Days Open	Year	Thawing Date	Freezing Date	Days Open
1825	April 15	November 20	219	1868	April 26	November 16	204	1911	April 19	November 15	213
1826	April 17	November 14	211	1869	April 21	November 25	218	1912	April 18	December 2	233
1827	April 6	December 3	241	1870	April 11	November 27	230	1913	April 1	December 7	250
1828	April 20	November 19	213	1871	April 10	November 20	224	1914	April 27	November 19	206
1829	April 17	December 15	242	1872	April 28	November 26	212	1915	April 12	December 12	244
1830	April 18	November 29	235	1873	April 26	November 11	199	1916	April 12	November 15	217
1831	April 10	December 7	241	1874	April 24	November 17	207	1917	April 19	November 25	220
1832	May 3	November 15	196	1875	May 2	November 17	199	1918	April 15	November 29	228
1833	April 10	November 5	209	1876	April 24	November 29	219	1919	April 8	November 28	234
1834	April 11	November 17	220	1877	April 15	November 23	222	1920	April 15	November 22	221
1835	May 1	November 26	209	1878	April 20	December 18	242	1921	March 28	November 15	232
1836	April 28	November 14	200	1879	April 9	November 21	226	1922	April 8	November 23	229
1837	April 17	November 9	206	1880	April 24	November 22	212	1923	April 25	December 18	237
1838	May 1	November 25	208	1881	May 2	November 21	203	1924	April 23	December 2	223
1839	April 23	November 23	214	1882	May 1	November 26	209	1925	April 1	November 23	236
1840	April 16	November 23	221	1883	April 18	November 16	212	1926	May 1	December 4	217
1841	April 27	November 27	214	1884	April 16	November 19	217	1927	April 17	December 4	231
1842	April 24	November 22	212	1885	April 23	November 27	218	1928	April 14	November 27	227
1843	April 26	November 14	202	1886	April 24	November 23	213	1929	April 19	November 23	218
1844	April 14	November 24	224	1887	April 27	December 1	218	1930	April 3	December 3	244
1845	April 23	December 4	225	1888	April 26	November 21	209	1931	April 3	December 3	244
1846	April 6	November 28	236	1889	April 16	December 1	229	1932	April 9	November 27	232
1847	May 2	November 20	202	1890	April 21	November 24	217	1933	April 17	November 11	208
1848	April 19	November 13	208	1891	April 14	November 20	220	1934	April 14	December 8	238
1849	April 8	December 1	237	1892	April 15	December 5	234	1935	April 22	December 4	226
1850	April 30	November 27	211	1893	April 14	November 21	221	1936	March 19	November 19	245
1851	April 26	November 21	209	1894	April 16	November 20	218	1937	April 14	December 11	241
1852	April 30	December 12	226	1895	April 18	December 6	232	1938	April 15	November 25	224
1853	April 13	November 25	226	1896	April 18	November 22	218	1939	April 26	November 24	212
1854	May 7	December 10	217	1897	April 22	December 2	224	1940	April 14	November 27	227
1855	April 27	November 20	207	1898	April 16	December 7	235	1941	April 15	November 28	227
1856	April 25	November 15	204	1899	April 21	November 13	206	1942	April 19	November 21	216
1857	April 17	November 26	223	1900	April 20	November 28	222	1943	April 24	December 2	222
1858	April 22	November 11	203	1901	April 8	November 22	228	1944	April 21	December 3	226
1859	April 15	November 23	222	1902	March 23	December 3	255	1945	March 31	November 26	240
1860	April 25	November 26	215	1903	April 1	November 20	233	1946	March 29	November 30	246
1861	April 18	December 2	228	1904	April 21	November 13	206	1947	April 18	November 23	219
1862	April 24	November 25	215	1905	April 11	November 20	223	1948	April 9	December 16	251
1863	April 26	November 6	194	1906	April 19	November 28	223	1949	April 5	November 27	236
1864	April 21	November 25	218	1907	April 24	December 8	223	1950	April 21	December 22	245
1865	April 12	November 27	229	1908	April 26	November 19	207	1951	April 4	November 28	238
1866	April 10	November 20	224	1909	April 15	December 12	241	1952	April 13	December 2	232
1867	April 24	November 16	206	1910	April 4	December 4	244	1953	March 28		

FLOOD–STAGE RECORDS OF THE RIVER NILE

by C. S. Jarvis

TABLE 1

MAXIMUM ANNUAL STAGES OF THE NILE RIVER AT THE RODA GAGE, CAIRO EGYPT
AS RECORDED DURING 13 CENTURIES, 622 TO 1921 A.D.
EXPRESSED IN METERS ABOVE MEDITERRANEAN SEA-LEVEL AT ALEXANDRIA

Years After Base Year	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900
0		18.03	17.66	17.64	17.39	17.76	15.70	17.41	18.04	17.88	18.65		19.91	18.70
1		16.54	17.72	17.39	17.58	17.96	17.17	17.78	18.29	18.34	17.97	19.37	20.05	18.78
2		17.85	16.58	17.79	17.79	17.62	17.32	17.49	17.85	18.21	18.12	19.60	17.88	18.02
3		17.58	16.29	15.77	17.51	17.96	17.75	17.89	17.89	18.01	20.16	18.41	17.32	19.17
4		16.67	17.53	17.36	17.78	17.76	17.85	17.52	17.49	18.03	18.37	18.65	17.32	18.22
5		17.55	18.17	17.36	17.38	17.79	17.99	17.48	18.19	17.88	18.97	17.88	18.13	18.18
6		17.52	17.63	17.55	17.52	17.67	17.79	17.51	18.14	18.18	17.90	17.88	17.86	19.15
7		17.56	18.16	17.28	16.63	17.66	17.66	17.69	18.29	18.09	18.68	19.24	17.73	18.02
8		17.63	17.79	17.80	16.99	17.77	17.69	17.90	18.27	18.21	18.93	18.65	17.59	20.14
9		17.50	17.41	17.65	17.62	17.67	17.48	17.70	18.17	18.13	19.12	18.41	18.97	19.87
10		17.56	17.85	17.74	17.69	17.66	17.52	17.35	18.43	17.85	18.36	18.97	18.13	19.73
11		17.40	17.28	17.70	17.36	17.66	17.03	17.92	18.39	18.26	20.05	17.88	19.51	19.06
12		17.57	16.36	17.77	17.48	18.01	17.65	17.58	18.13	18.55	20.05	17.88	19.24	18.51
13		16.29	18.36	17.90	17.80	17.91	17.96	17.59	18.09	18.32	18.48	18.13	18.97	17.17
14		17.74	17.67	17.89	17.36	17.91	17.82	17.42	18.21	18.60	19.12	18.32	18.15	19.10
15		17.87	17.63	17.51	17.39	17.63	17.97	17.80	18.43	18.29	18.95	17.35	18.15	18.14
16		17.40	18.34	17.50	17.66	17.89	17.73	17.86	18.43	18.43	18.32	17.35	18.70	20.23
17		17.84	16.67	17.21	17.84	17.83	17.59	17.95	18.24	18.04	18.13	17.88	19.51	20.47
18		17.84	17.12	17.37	18.26	18.09	17.42	17.53	18.00	17.95			20.05	18.24
19		18.05	17.36	17.83	17.38	17.96	16.92	17.47	18.04	18.24			18.15	18.68
20		18.12	18.33	17.84	17.39	17.90	17.39	17.59	17.93	17.94	17.88	18.24	18.15	18.73
21		17.95	17.82	17.65	17.39	17.97	17.39	17.40	18.17	18.41	17.87	18.95		18.88
22	17.58	17.05	17.45	17.72	16.94	17.42	17.69	17.58	18.56	18.12	19.12	19.46	19.51	
23	17.37	17.80	17.78	17.38	17.53	17.72	17.48	17.95	18.14		20.05	18.65		
24	17.64	18.06	17.70	17.95	17.41	17.43	17.60	18.10	17.77			19.51	18.16	
25	17.47	17.64	17.70	17.67	17.79	17.90	17.56	17.58	18.43		20.05	18.38	18.20	
26	17.50	16.90	17.70	17.68	17.74	17.87	17.90	17.56	18.43			19.19	19.37	
27	18.02	17.66	17.67	16.58	17.67	17.51	17.75	17.67	17.64			19.89	19.37	
28	17.55	17.63	17.14	17.89	17.35	17.89	17.40	17.99	18.43			19.17	18.85	
29	16.38	17.79	17.57	17.60	17.41	17.64	17.47	17.67	18.33			19.51	20.09	
30	17.43	17.50	16.20	17.64	17.63	17.66	17.38	17.73	18.56		17.32		18.78	
31	17.45	17.89	17.79	16.90	17.41	17.55	17.35	17.59	18.56		18.43	18.58	19.21	
32	16.85	17.84	16.40	17.77	17.74	17.47	17.38	18.01	18.48		17.88	19.69	18.95	
33	18.50	16.78	16.81	17.48	17.58	17.78	17.95	17.79	18.57			19.03	18.14	
34	17.80	17.35	17.17	17.77	17.77	17.86	17.38	17.59	17.67		17.88	18.80	19.53	
35	18.36	16.72	17.45	17.52	17.80	17.92	17.49	18.01	18.57		18.16	19.26	18.32	
36	18.05	17.84	17.17	17.87	17.01	17.95	17.64	17.89	18.56			20.14	18.61	
37	17.83	16.96	16.72	17.52	17.26	17.79	17.60	17.79	18.22			18.63	18.20	
38	17.36	17.37	17.60	17.45	17.84	17.67	17.43	17.57	18.59		17.88	20.32	18.83	
39	18.01	17.52	17.67	16.74	17.79	17.94	17.47	17.46	18.11		17.88	19.78	18.41	
40	17.51	17.21	17.57	17.41	17.85	17.77	17.56	17.70	18.55		17.32	20.18	19.91	
41	18.04	18.03	16.09	16.99	17.53	17.75	17.80	17.56	18.66		16.81	19.69	20.05	
42	16.92	18.03	16.09	16.99	17.79	17.47	17.58	17.99	18.66			19.78	19.82	
43	17.43	17.49	17.63	18.17	17.95	17.89	17.43	17.62	18.66			19.24	19.10	
44	17.48	17.36	17.42	17.45	17.84	15.32	17.97	18.06	18.41			19.51	19.03	
45	17.41	17.86	17.38	17.08	17.85	17.67	16.81	18.07	18.04		19.51	20.05	18.59	
46	17.83	17.64	17.38	17.17	17.79	17.95	18.04	18.05	18.23			19.93	20.02	
47	17.68	17.76	17.23	17.17	17.66	17.84	17.72	17.78	18.40		17.88	20.11	19.48	
48	17.51	17.39	16.81	16.81	17.62	18.03	17.83	17.60	18.14			19.10	20.18	
49	17.62	17.39	17.84	16.69	17.79	17.95	17.70	17.87	17.92			18.94	20.16	

EDITOR'S NOTE

IF we are ever to learn much about cycles, and particularly if we are to use a knowledge of cycles to beat the woolly bears at long range weather forecasting, we must have long series of figures with which to work.

It is therefore with great pleasure that we present to cycle students everywhere a series of figures giving maximum and minimum annual stages of the river Nile as recorded at the Roda Gage, Cairo, Egypt, from 622 A.D. to 1921 A.D. These figures, converted from pics, kirats, condees, doights, cubits and digits to their metrical equivalents, were prepared from Egyptian records by C. S. Jarvis. They have never before been published in their present form.

Before doing serious work with these figures you will want to refer to a paper by Dr. Jarvis entitled, "Flood Stages of the River Nile" originally published in

Table 1 (continued)

Years After Base Year	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900
50	15.93	17.36	17.12	17.17	17.79	18.06	17.64	17.62	17.08		17.35	19.53	18.92	
51	17.55	17.99	16.58	17.08	17.67	17.76	18.09	17.63	17.97			20.05	20.25	
52	17.49	18.06	17.12	17.37	17.79	17.90	18.07	18.06	18.29			18.57	18.78	
53	17.69	17.38	17.57	17.42	17.66	17.93	17.80	18.06	18.13	17.32		18.61	20.25	
54	17.35	17.95	17.62	17.37	17.76	17.63	17.75	18.21	18.28			19.35	20.02	
55	17.37	17.65	17.67	17.89	17.65	17.84	17.89	18.12	18.31			19.66	18.63	
56	17.91	16.72	17.67	17.42	17.48	17.80	17.92	18.38	18.29			19.35	20.23	
57	17.37	17.57	17.67	17.63	17.10	17.70	17.92	17.95	18.06			20.32	18.94	
58	17.56	17.70	17.84	17.56	17.47	18.00	17.67	18.16	18.06		19.34	19.24	18.85	
59	17.40	17.10	17.49	17.50	17.55	18.00	17.90	18.20	18.17			18.91	18.77	
60	17.95	17.79	17.26	17.77	17.89	16.78	18.01	20.05	18.32			20.07	20.16	
61	17.62	17.17	17.50	17.89	17.48	17.96	17.49	18.00	17.85			19.08	20.41	
62	17.23	17.12	17.68	17.42	17.40	17.82	17.89	17.64	17.95			18.48	19.51	
63	17.67	17.17	18.28	17.28	17.52	17.82	17.76	17.66	18.23			20.14	20.61	
64	17.90	16.69	17.78	16.90	17.69	17.99	17.75	17.75	18.30			19.64	18.39	
65	17.40	17.26	17.70	17.51	17.42	17.80	17.50	17.79	18.16			18.36	19.48	
66	18.06	17.43	17.84	16.69	16.94	17.86	18.02	17.79	17.95			18.07	20.90	
67	17.63	17.26	17.73	15.58	17.55	17.59	17.50	18.22	18.20			19.69	19.17	
68	17.90	17.64	17.48	17.50	17.62	17.87	17.89	17.89	18.02			20.07	18.30	
69	17.41	16.83	17.66	17.45	17.55	17.75	17.68	17.63	18.23			19.03	21.15	
70	17.39	16.83	17.82	17.56	17.43	17.69	17.86	17.55	17.61		18.97	19.87	20.43	
71	17.99	17.14	17.86	17.39	17.49	17.72	17.48	17.66	17.61			19.91	19.84	
72	17.66	17.21	17.49	17.62	17.23	17.84	18.01	17.93	17.61			18.33	20.05	
73	17.43	17.12	17.40	17.64	17.55	17.93	17.76	17.98	17.61	18.70		18.76	18.56	
74	17.43	17.84	17.86	17.83	17.38	17.73	17.63	17.23	17.48			19.10	21.40	
75	17.41	17.37	17.67	17.83	17.70	17.80	17.65	17.67	17.61			19.78	20.14	
76	17.48	16.83	17.82	17.83	17.50	17.73	17.68	18.02	17.61			18.49	20.38	
77	17.51	17.35	17.85	17.23	17.76	17.58	18.01	18.24			18.43	19.24	17.65	
78	16.90	17.93	17.85	17.35	17.76	17.74	17.97	18.02	18.66			19.64	21.26	
79	17.66	17.32	17.85	17.39	17.76	17.56	17.94	18.22	17.61			20.05	20.29	
80	17.66	16.94	17.77	17.35	17.84	17.96	17.90	17.66	17.94			19.78	18.88	
81	17.70	17.14	16.58	17.45	17.51	17.52	17.60	18.29	17.61			19.10	20.07	
82	17.39	16.58	17.80	16.87	17.69	17.94	17.93	18.46	17.61		18.16	17.95	18.80	
83	17.12	17.63	17.84	17.64	17.69	17.64	17.70	18.31	17.61	18.70		17.95	20.07	
84	17.41	17.63	17.84	17.70	17.76	18.03	17.65	18.24	17.86			18.03	19.21	
85	17.40	17.28	17.28	17.52	17.01	17.62	17.57	17.78	17.61			18.43	19.37	
86	17.41	17.78	17.40	17.57	17.78	17.85	17.66	18.43	18.12			19.01	19.12	
87	16.36	17.58	17.23	17.52	17.69	17.76	17.73	18.05	18.17	19.28		19.35	20.63	
88	16.42	16.86	16.99	17.41	17.93	17.60	17.93	18.20	17.61	18.70	18.97	19.24	18.04	
89	17.05	16.87	17.75	17.10	17.72	17.86	17.73	17.66	17.61	18.19		19.01	19.44	
90	17.52	17.43	17.82	17.87	17.89	17.93	17.19	17.91	17.72	18.59	18.97	18.90	19.82	
91	17.23	16.67	17.82	17.48	17.70	18.04	17.69	18.17	17.98			18.31	19.42	
92	17.38	17.17	17.82	17.66	17.49	17.74	17.83	18.29	17.80		17.88	18.43	20.63	
93	17.14	17.52	17.52	17.66	17.49	17.97	17.75	17.85	17.88	18.48		18.29	19.39	
94	15.93	17.26	17.26	17.47	17.60	17.59	16.99	17.85	17.88	20.25		18.26	20.52	
95	17.83	17.79	16.58	17.45	17.75	17.73	17.53	18.24	17.88	18.63	15.83	18.66	20.00	
96	17.84	17.01	17.56	17.32	18.06	17.75	17.90	18.18	17.88	19.73		18.56	19.82	
97	18.10	16.81	17.23	17.43	18.04	17.85	17.21	18.29	17.35	18.66		18.60	19.10	
98	17.79	17.62	17.70	17.70	18.06	17.91	17.03	17.95	17.88		20.05	19.48	19.98	
99	17.55	16.78	17.56	17.57	17.51	17.79	17.43	17.94	17.88		17.88	18.76	17.57	

the August 1935 *Proceedings of the American Society of Civil Engineers* and subsequently reprinted in the *Transactions* of that organization, Vol. 101 (1936) p. 1012. You can buy this paper (Paper No. 1944) from the Society at 39 W. 39th Street for sixty cents a copy.

In a letter dated February 12, 1951, in speaking of these data, Dr. Jarvis writes, " .....the 13 centuries of hydrologic record had to be drawn piecemeal from a number of sources, all duly acknowledged in the August 1935 Proceedings as well as the 1936 Transactions, (pages 1012 to 1071), of the A.S.C.E. Those records based on the Mohammedan system of time reckon-

TABLE 2

MINIMUM ANNUAL STAGES OF THE NILE RIVER AT THE RODA GAGE, CAIRO, EGYPT AS RECORDED DURING 13 CENTURIES, 622 TO 1921 A.D. EXPRESSED IN METERS ABOVE MEDITERRANEAN SEA-LEVEL AT ALEXANDRIA

Years After Base Year	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900
0		11.80	10.34	12.50	10.74	14.57	10.97	10.43	10.43		11.60			13.17
1		11.42	10.65	12.05	11.01	12.99	9.89	10.43	10.43		10.83			13.87
2		12.77	9.89	13.10	12.20	12.77	9.66		11.28		10.76		11.01	13.89
3		12.06	10.34	12.50	11.96	12.77	10.47	10.43	10.34		11.06	12.14	11.01	14.00
4		10.76	10.02	11.55	10.97	11.78	10.56	10.43	10.65		11.26	11.62		14.34
5		10.76	11.28	11.01	12.07	12.70	11.10	10.97	9.57		11.71			14.52
6		11.89	11.78	11.00	11.19	13.13	12.90	10.97	9.89		10.81			14.77
7		11.21	10.97	11.03	11.60	13.33	11.51	10.97	10.16		10.85	11.78		14.63
8		11.78	11.42	11.21	11.51	12.70	11.66	12.60	10.70		11.17	11.30		14.48
9		10.31	14.66	11.21	10.25	12.45	11.96	12.60	10.97		10.83	11.15	11.24	14.95
10		10.76	10.97	10.97	10.97	12.45	11.96		11.51		11.46	10.94		14.72
11		11.78	11.37	11.06	11.37	12.11	11.10	9.95	10.43					14.75
12		12.09	10.97	12.59	10.07	12.65	11.10	9.95	12.23		11.17			14.45
13		10.22	12.59	12.61	10.34	13.46	11.19	10.43	10.43		10.85	11.82	12.32	14.81
14		12.20	13.13	11.24	10.43	13.46	11.19	10.02	12.59		12.11	12.02	10.70	14.12
15		10.70	11.73	11.96	10.43	12.90	10.74	10.97	12.32		11.26	11.55		14.48
16		11.26	11.69	12.05	9.80	12.95	11.06	11.01	12.32	15.24	11.60	12.05		14.70
17		10.58	11.73	12.05	10.79	12.86	11.28	11.55	12.05	13.49	10.49			14.89
18		12.16	10.88	11.19	11.69	12.59	12.18	9.19	11.15	12.27				15.30
19		13.58	11.91	10.88	12.50	12.54	10.98		11.01	12.50				14.97
20		11.84	11.46	12.50	13.24	14.21	10.44	10.43	10.43	12.27		12.09		14.41
21		10.83	11.60	10.94	12.09	12.68	10.56	11.44	11.42	12.23	9.01	11.37		14.45
22	11.57	10.97	11.42	11.98	11.42	12.63	10.58	11.01	11.66	12.81	10.72	12.61		
23	10.88	11.19	11.28	11.21	10.61	13.35	10.98	11.33	12.27		11.95	11.35		
24	11.69	10.97	11.69	11.64	10.00	13.13	10.43	11.51	12.50			12.02		
25	11.69	10.97	11.62	12.11	10.88	12.65	10.38	10.02	11.73			11.28		
26	9.84	11.53	11.15	11.53	11.28	13.19	11.42	13.35	11.08			10.61	11.78	
27	13.22	11.53	11.64	11.46	11.42	13.51	11.42	12.50	11.84			11.55	11.78	
28	11.78	11.51	10.88	11.26	12.59	12.77	11.93	11.96	10.43			11.01		
29	11.03	11.51	10.79	12.88	11.42	13.17	11.03	10.97	11.66			10.56		
30	12.11	11.51	10.83	11.75	11.48	12.68	9.89	11.55	12.11			11.78		
31	12.92	11.84	10.43	11.71	10.88	12.63	9.36	10.43	12.11	9.01		11.98		
32	11.24	10.97	11.10	10.81	11.42	11.12	11.42	11.64	12.50			11.08	12.32	
33	11.71	10.43	10.92	11.33	11.19	12.07	11.42	10.61	12.11			13.10		
34	11.33	10.43	11.10	11.64	11.30	12.92	11.51	10.07				11.17		
35	12.27	10.02	10.47	11.55	10.88	12.05	11.51	11.89	12.00			12.14		
36	11.42	11.52	10.76	11.55	12.50	12.23	11.80	11.89	14.95			13.17	11.33	
37	12.16	10.97	11.10	11.55	11.37	12.05	12.59	11.37	12.45			11.55	11.69	
38	12.59	10.34	10.43	11.60	11.08	11.53	11.96	11.84	12.02			11.51		
39	12.99	10.02	11.03	10.94	11.10	11.82	11.42	11.30	12.02				11.80	
40	12.32	9.89	10.34	10.54	11.73	12.45	11.69	11.08	11.19				12.95	
41	11.17	10.92	10.74	10.67	11.73	12.05	11.96	11.44	12.14				11.82	
42	11.55	11.15	10.52	10.44	11.96	11.51	11.42	12.27	14.48				13.13	
43	12.32	11.15	10.11	9.48	11.89	10.79	11.28	11.01	13.24				12.70	
44	10.83	10.47	10.97	10.99	12.00	11.51	10.43	11.96	12.50				12.20	
45	10.20	10.40	10.92	10.16	13.51	10.81	10.97	12.77	12.38				12.16	
46	13.94	10.38	11.10	10.65	12.74	11.28	11.42	11.33	11.84				12.52	
47	11.96	10.85	11.15	10.67	12.27	12.09	12.05	11.51	14.99				11.87	
48	11.48	11.26	10.97	10.72	13.10	11.57	12.05	11.42	12.45				11.82	
49	10.83	10.58	11.96	10.76	11.48	12.77	11.64	11.06	12.92			11.21	11.75	

ing, including just 12 lunar cycles per year, naturally got out of phase with the Gregorian reckoning. It was found that every 33 or 34 years of our reckoning, we had to discard one of the supernumeray years that had resulted from that lunar reckoning; but I always made it a point to examine the data very closely, and to avoid errors and omissions or duplications."

All data were transcribed from Volumes 4 and 9, *Memoires* a L'Institut D'Egypte, 1923 to 1925, compiled by Prince Omar Toussoun. Preference was given to the long tabulation of Volume 9; only missing data were supplied by reference to the Aboul Mehasin tabulation of Volume 4 and the textual notes with cross references of Ibn Ijas and others.

Readings are expressed in meters and centimeters above mean sea-level of the Mediterranean at Alexandria, Egypt.

May 2, 1951

Table 2 (continued)

Years After Base Year	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900
50	11.89	10.67	11.15	10.81	11.51	12.59	11.60	11.24	12.38			10.79	11.75	
51	11.33	11.15	11.62	11.96	11.51	12.09	11.96	12.16	11.24			10.90	12.07	
52	10.34	12.63	11.51	11.96	11.82	12.20	11.12	11.78	12.05				12.50	
53	11.57	11.24	11.42	11.51	11.82	11.84	11.69	11.51	13.24			11.28	12.11	
54	10.34	11.10	11.26	10.88	11.51	12.20	11.10	11.26	12.92			11.42	12.41	
55	10.97	10.97	11.08	11.28	11.33	11.93	11.78	11.82	12.70			10.92	12.86	
56	12.99	10.97	11.87	11.51	11.30	12.47	11.33	11.60	12.95			11.78	12.36	
57	11.57	11.57	11.91	12.36	11.51	12.52	11.53	12.63	12.99				12.59	
58	11.30	10.00	11.53	12.16	11.66	12.59	11.39	11.15	12.77		11.66		12.07	
59	11.55	9.91	12.54	12.88	10.70	12.99	11.55	11.57	12.36				12.11	
60	13.49	9.95	11.87	12.97	12.00	11.73	11.87	15.24	12.05			11.93	12.50	
61	12.32	10.13	11.96	11.82	10.74	11.82	11.96	11.78	12.32			11.01	12.72	
62	11.03	10.07	13.31	13.06	11.10	11.80	12.20	12.05	12.27			10.83	13.22	
63	11.03	9.71	14.12	10.43	12.92	11.80	11.66		13.04			11.39	13.17	
64	10.83	9.71	13.49	11.84	11.78	13.31	11.28	11.64	13.04			11.24	13.44	
65	10.27	9.80	12.90	10.54	11.28	12.07	11.01	11.60	12.68			11.98	12.83	
66	11.66	9.93	12.11	11.69	10.97	12.36	11.57	11.60	12.90			12.56	13.06	
67	11.48	10.43	12.32	10.43	13.04	11.51	11.75	12.05	12.50			11.15	13.01	
68	12.50	10.97	11.66	9.80	11.03	11.82	11.42	11.28	12.32			10.85	12.99	
69	11.55	9.82	11.24	10.72	12.59	11.42	11.87	11.96	11.96			11.94	12.79	
70	10.47	9.71	11.46	11.89	11.19	11.91	12.54	11.53	12.50			11.57	12.74	
71	10.54	9.71	10.79	11.51	11.19	12.59	11.98	12.07				12.63	12.90	
72	10.18	10.65	11.08	11.42	11.19	11.66	12.63	13.15					12.25	
73	11.89	10.22	10.97	11.93	10.81	11.96	12.83	11.73					12.65	
74	11.26	10.29	11.06	11.51	11.96	12.41	12.52	11.73					12.61	
75	12.50	9.89	10.72	10.97	10.85	12.52	11.60	11.24					12.70	
76	12.97	10.29	10.65	11.44	11.01	12.41	12.34	11.51					12.81	
77	11.78	9.95	11.28	10.97	11.03	12.52	12.34	11.87					12.83	
78	10.43	9.82	13.40	10.94	11.46	11.57	12.32	12.05					12.00	
79	11.03	10.90	9.59	11.53	12.11	11.26	13.06	12.54					14.21	
80	12.50	9.80	9.59	11.08	11.69	11.64	12.05	12.18					13.37	
81	12.72	9.71	11.37	9.35	11.44	10.88	10.54	11.69					12.70	
82	11.69	9.57	11.33	10.81	11.91	11.73	11.51	12.60					12.29	
83	10.04	9.89	11.37	10.81	11.89	12.52	11.08	13.13	12.14				12.32	
84	10.83	9.66	11.51	10.97	11.82	12.88	10.97	13.31				11.24	13.37	
85	11.64	9.89	11.17	11.46	12.43	13.01	10.97	12.14	13.58				13.26	
86	11.24	10.22	11.57	12.50	12.43	12.86	10.97	12.05					13.37	
87	10.27	10.74	11.57	11.51	12.27	12.23	11.60	12.14		11.42			13.08	
88	9.95	11.10	11.33	10.43	11.89	12.32	10.97	12.23	13.58	10.43			13.19	
89	11.69	11.10	11.10	10.43	11.91	11.84	10.47	11.96		10.65			13.13	
90	12.70	10.61	11.55	10.43	11.55	12.07	11.03	11.78	12.41	10.85			13.17	
91	10.11	11.51	11.89	10.70	12.09	12.50		11.42					13.67	
92	12.47	11.28	12.60	11.24	12.18	12.56	12.95	13.04					13.49	
93	11.01	10.74	11.89	11.37	12.11	12.11	12.27	12.36		10.90			13.91	
94	10.04	10.43	11.51	11.46	12.09	12.16	10.97	12.05		11.51			13.80	
95	10.04	10.34	10.97	10.99	11.64	12.09	9.35	11.06		12.11			14.12	
96	10.65	10.74	12.09	10.54	11.35	12.09	11.60	12.32		11.35		12.61	13.87	
97	12.23	9.66	11.30	10.45	11.21	12.07		11.96		11.75			13.94	
98	11.84	10.27	12.95	10.70	11.37	11.51	10.97	11.78					13.76	
99	12.16	10.29	13.08	11.42	12.54	10.97	11.51	12.90					14.21	

TABLE 3, 5-YEAR AVERAGES OF MAXIMA

Years After Base Year	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900
02-06		17.43	17.24	17.17	17.60	17.76	17.74	17.58	17.91	18.06	18.70	18.48	17.70	18.55
07-11		17.53	17.70	17.63	17.26	17.68	17.48	17.71	18.31	18.11	19.02	18.64	18.39	19.36
12-16		17.37	17.67	17.71	17.54	17.87	17.83	17.65	18.26	18.44	18.98	17.81	18.64	18.63
17-21		17.96	17.46	17.59	17.65	17.95	17.34	17.59	18.08	18.12	17.96	18.36	18.96	19.00
22-26	17.51	17.49	17.67	17.68	17.48	17.67	17.65	17.75	18.27	18.12	19.74	19.04	18.81	
27-31	17.37	17.69	17.27	17.32	17.50	17.65	17.47	17.73	18.30		17.87	19.29	19.26	
32-36	17.91	17.31	17.00	17.68	17.58	17.80	17.57	17.86	18.37		17.97	19.38	18.71	
37-41	17.75	17.41	17.13	17.22	17.65	17.78	17.57	17.62	18.43		17.47	19.72	19.08	
42-46	17.41	17.68	17.18	17.37	17.84	17.26	17.57	17.96	18.40		19.51	19.70	19.31	
47-51	17.26	17.58	17.12	16.99	17.71	17.92	17.79	17.70	17.90		17.61	19.54	19.80	
52-56	17.56	17.55	17.53	17.49	17.67	17.82	17.89	18.17	18.26	17.32		19.11	19.58	
57-61	17.58	17.47	17.55	17.67	17.50	17.68	17.79	18.47	18.09		19.34	19.52	19.42	
62-66	17.65	17.13	17.86	17.16	17.39	17.86	17.78	17.73	18.12			18.94	19.78	
67-71	17.66	17.14	17.71	17.10	17.53	17.72	17.68	17.79	17.94		18.97	19.71	19.78	
72-76	17.48	17.27	17.65	17.75	17.47	17.81	17.75	17.77	17.58	18.70		18.89	20.11	
77-81	17.48	17.34	17.58	17.35	17.73	17.67	17.88	18.09	17.95		18.43	19.56	19.63	
82-86	17.35	17.38	17.63	17.46	17.59	17.82	17.70	18.24	17.76	18.70	18.16	18.27	19.31	
87-91	16.91	17.08	17.53	17.48	17.79	17.84	17.66	18.00	17.82	18.69	18.97	18.96	19.47	
92-96	17.22	17.35	17.35	17.51	17.68	17.76	17.60	18.08	17.86	19.27	16.85	18.44	20.07	
97-01	17.60	17.32	17.50	17.53	17.86	17.28	17.37	18.10	17.87	18.43	19.10	19.36	18.83	

TABLE 4, 5-YEAR AVERAGES OF MINIMA

Years After Base Year	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900
02-06		11.65	10.66	11.83	11.68	12.63	10.94	10.70	10.35		11.12	11.88	11.01	14.30
07-11		11.17	11.88	11.09	11.14	12.61	11.64	11.53	10.75		11.08	11.29	11.24	14.71
12-16		11.29	12.02	12.09	10.21	13.08	11.06	10.48	11.98	15.24	11.40	11.86	11.51	14.51
17-21		11.80	11.52	11.51	12.07	12.98	11.08	10.83	11.21	12.55	9.75	11.73		14.81
22-26	11.13	11.13	11.43	11.69	10.84	12.99	10.76	11.44	11.85	12.81	11.33	11.57	11.78	
27-31	12.21	11.57	10.91	11.81	11.56	12.95	10.72	11.48	11.63	9.01		11.37	11.78	
32-36	11.59	10.67	10.87	11.38	11.46	12.08	11.53	11.22	12.89			12.13	11.82	
37-41	12.25	10.43	10.73	11.06	11.40	11.98	11.93	11.41	11.96			11.53	12.06	
42-46	11.77	10.71	10.72	10.34	12.42	11.18	11.10	11.87	12.89				12.54	
47-51	11.49	10.90	11.37	10.88	11.98	12.22	11.86	11.47	12.79			10.97	11.86	
52-56	11.24	11.38	11.43	11.43	11.56	12.13	11.40	11.59	12.77			11.35	12.45	
57-61	12.04	10.32	11.96	12.43	11.32	12.33	11.66	12.48	12.50		11.66	11.47	12.40	
62-66	10.96	9.84	13.19	11.51	11.61	12.27	11.54	11.72	12.79			11.60	13.14	
67-71	11.30	10.13	11.49	10.87	11.81	11.85	11.92	11.78	12.32			11.63	12.90	
72-76	11.76	10.27	10.90	11.45	11.16	12.19	12.38	11.87					12.60	
77-81	11.69	10.03	11.04	10.77	11.55	11.57	12.06	12.07					13.02	
82-86	11.09	9.85	11.39	11.31	12.10	12.60	11.13	12.65	12.86			11.24	12.92	
87-91	10.94	11.01	11.49	10.70	11.94	12.19	11.01	11.91	13.00	10.84			13.25	
92-96	10.84	10.71	11.81	11.12	11.87	12.20	11.43	12.17		11.47		12.61	13.84	
97-01	11.89	10.23	12.38	10.86	12.54	11.08	10.83	11.49		11.39			13.79	

TABLE 5, 10-YEAR AVERAGES OF MAXIMA

Years After Base Year	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900
02-11		17.482	17.469	17.400	17.427	17.722	17.608	17.645	18.111	18.085	18.866	18.557	18.044	18.956
12-21		17.667	17.566	17.647	17.595	17.910	17.584	17.619	18.167	18.277	18.600	18.013	18.786	18.815
22-31	17.439	17.592	17.470	17.501	17.488	17.659	17.558	17.742	18.285	18.120	18.994	19.149	19.060	
32-41	17.831	17.362	17.065	17.452	17.617	17.790	17.570	17.737	18.398		17.687	19.552	18.895	
42-51	17.336	17.627	17.148	17.178	17.775	17.594	17.681	17.829	18.151		18.247	19.624	19.555	
52-61	17.571	17.509	17.541	17.582	17.583	17.754	17.842	18.319	18.176	17.320	19.340	19.316	19.504	
62-71	17.658	17.137	17.783	17.128	17.461	17.791	17.733	17.758	18.026		18.970	19.326	19.778	
72-81	17.484	17.305	17.614	17.552	17.599	17.739	17.815	17.926	17.775	18.700	18.430	19.227	19.868	
82-91	17.131	17.231	17.577	17.468	17.686	17.827	17.678	18.121	17.790	18.692	18.700	18.618	19.392	
92-01	17.413	17.334	17.426	17.523	17.772	17.520	17.486	18.092	17.865	18.910	18.202	18.900	19.449	

TABLE 6, 10-YEAR AVERAGES OF MINIMA

Years After Base Year	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900
02-11		11.408	11.270	11.464	11.409	12.619	11.288	11.115	10.550		11.101	11.488	11.125	14.505
12-21		11.546	11.769	11.801	11.138	13.030	11.072	10.633	11.595	13.000	10.927	11.817	11.510	14.658
22-31	11.673	11.353	11.173	11.753	11.198	12.971	10.742	11.463	11.739	10.910	11.330	11.475	11.780	
32-41	11.920	10.551	10.799	11.218	11.430	12.029	11.728	11.313	12.375			11.960	11.985	
42-51	11.633	10.806	11.047	10.664	12.197	11.701	11.482	11.673	12.842			10.970	12.197	
52-61	11.644	10.847	11.695	11.933	11.439	12.229	11.532	12.034	12.635		11.660	11.390	12.423	
62-71	11.136	9.986	12.340	11.191	11.709	12.059	11.728	11.753	12.579			11.614	13.015	
72-81	11.726	10.152	10.971	11.114	11.355	11.883	12.223	11.969					12.813	
82-91	11.016	10.429	11.439	11.005	12.019	12.396	11.063	12.276	12.928	10.838		11.240	13.085	
92-01	11.366	10.474	12.094	10.992	12.205	11.642	11.164	11.833		11.436		12.610	13.814	

In certain instances the 5- and 10-year averages are based on incomplete data. Refer to Table 1.

STANDARD QUARTER-YEAR NUMBERS

A standard series of quarter-year numbers is given in the table below. Just as month numbers are almost indispensable in the cycle analysis of monthly data, so also quarter year numbers are of the greatest possible assistance in dealing with quarterly data.

The quarter year numbers that are used by the Foundation for the Study of Cycles are given in the table below. The fourth quarter in 1650 is base 0. In dealing with short series of figures you can, if you wish, subtract 1000 from each of the numbers starting with the fourth quarter of 1900.

You will notice that the number given for the fourth quarter of each year, starting 1901, is 1000 plus four times the value of the last two digits of the year. Thus the number for the fourth quarter of 1911 is 4 x 11 or 44, 1000, or 1044.

Conversely, quarter number 1200 would represent the fourth quarter of 1950 (1200 - 1000 = 200; 200 ÷ 4 = 50). Quarter number 1202 would be the second quarter of 1951 -two quarters after the fourth quarter of 1950 (1202 - 1000 = 202; 202 ÷ 4 = 50 plus a remainder of 2).

Quarter numbers are needed for time charts, for periodic tables, and for a variety of other manipulations of quarterly data.

This system of quarter year numbers was developed by Alexander Malinowski.

YEAR	1st	2nd	3rd	4th	YEAR	1st	2nd	3rd	4th	YEAR	1st	2nd	3rd	4th
1650					1700	197	198	199	200	1750	397	398	399	400
1651	1	2	3	4	1701	201	202	203	204	1751	401	402	403	404
1652	5	6	7	8	1702	205	206	207	208	1752	405	406	407	408
1653	9	10	11	12	1703	209	210	211	212	1753	409	410	411	412
1654	13	14	15	16	1704	213	214	215	216	1754	413	414	415	416
1655	17	18	19	20	1705	217	218	219	220	1755	417	418	419	420
1656	21	22	23	24	1706	221	222	223	224	1756	421	422	423	424
1657	25	26	27	28	1707	225	226	227	228	1757	425	426	427	428
1658	29	30	31	32	1708	229	230	231	232	1758	429	430	431	432
1659	33	34	35	36	1709	233	234	235	236	1759	433	434	435	436
1660	37	38	39	40	1710	237	238	239	240	1760	437	438	439	440
1661	41	42	43	44	1711	241	242	243	244	1761	441	442	443	444
1662	45	46	47	48	1712	245	246	247	248	1762	445	446	447	448
1663	49	50	51	52	1713	249	250	251	252	1763	449	450	451	452
1664	53	54	55	56	1714	253	254	255	256	1764	453	454	455	456
1665	57	58	59	60	1715	257	258	259	260	1765	457	458	459	460
1666	61	62	63	64	1716	261	262	263	264	1766	461	462	463	464
1667	65	66	67	68	1717	265	266	267	268	1767	465	466	467	468
1668	69	70	71	72	1718	269	270	271	272	1768	469	470	471	472
1669	73	74	75	76	1719	273	274	275	276	1769	473	474	475	476
1670	77	78	79	80	1720	277	278	279	280	1770	477	478	479	480
1671	81	82	83	84	1721	281	282	283	284	1771	481	482	483	484
1672	85	86	87	88	1722	285	286	287	288	1772	485	486	487	488
1673	89	90	91	92	1723	289	290	291	292	1773	489	490	491	492
1674	93	94	95	96	1724	293	294	295	296	1774	493	494	495	496
1675	97	98	99	100	1725	297	298	299	300	1775	497	498	499	500
1676	101	102	103	104	1726	301	302	303	304	1776	501	502	503	504
1677	105	106	107	108	1727	305	306	307	308	1777	505	506	507	508
1678	109	110	111	112	1728	309	310	311	312	1778	509	510	511	512
1679	113	114	115	116	1729	313	314	315	316	1779	513	514	515	516
1680	117	118	119	120	1730	317	318	319	320	1780	517	518	519	520
1681	121	122	123	124	1731	321	322	323	324	1781	521	522	523	524
1682	125	126	127	128	1732	325	326	327	328	1782	525	526	527	528
1683	129	130	131	132	1733	329	330	331	332	1783	529	530	531	532
1684	133	134	135	136	1734	333	334	335	336	1784	533	534	535	536
1685	137	138	139	140	1735	337	338	339	340	1785	537	538	539	540
1686	141	142	143	144	1736	341	342	343	344	1786	541	542	543	544
1687	145	146	147	148	1737	345	346	347	348	1787	545	546	547	548
1688	149	150	151	152	1738	349	350	351	352	1788	549	550	551	552
1689	153	154	155	156	1739	353	354	355	356	1789	553	554	555	556
1690	157	158	159	160	1740	357	358	359	360	1790	557	558	559	560
1691	161	162	163	164	1741	361	362	363	364	1791	561	562	563	564
1692	165	166	167	168	1742	365	366	367	368	1792	565	566	567	568
1693	169	170	171	172	1743	369	370	371	372	1793	569	570	571	572
1694	173	174	175	176	1744	373	374	375	376	1794	573	574	575	576
1695	177	178	179	180	1745	377	378	379	380	1795	577	578	579	580
1696	181	182	183	184	1746	381	382	383	384	1796	581	582	583	584
1697	185	186	187	188	1747	385	386	387	388	1797	585	586	587	588
1698	189	190	191	192	1748	389	390	391	392	1798	589	590	591	592
1699	193	194	195	196	1749	393	394	395	396	1799	593	594	595	596

STANDARD QUARTER—YEAR NUMBERS—CONTINUED

YEAR	1st	2nd	3rd	4th
1800	597	598	599	600
1801	601	602	603	604
1802	605	606	607	608
1803	609	610	611	612
1804	613	614	615	616
1805	617	618	619	620
1806	621	622	623	624
1807	625	626	627	628
1808	629	630	631	632
1809	633	634	635	636
1810	637	638	639	640
1811	641	642	643	644
1812	645	646	647	648
1813	649	650	651	652
1814	653	654	655	656
1815	657	658	659	660
1816	661	662	663	664
1817	665	666	667	668
1818	669	670	671	672
1819	673	674	675	676
1820	677	678	679	680
1821	681	682	683	684
1822	685	686	687	688
1823	689	690	691	692
1824	693	694	695	696
1825	697	698	699	700
1826	701	702	703	704
1827	705	706	707	708
1828	709	710	711	712
1829	713	714	715	716
1830	717	718	719	720
1831	721	722	723	724
1832	725	726	727	728
1833	729	730	731	732
1834	733	734	735	736
1835	737	738	739	740
1836	741	742	743	744
1837	745	746	747	748
1838	749	750	751	752
1839	753	754	755	756
1840	757	758	759	760
1841	761	762	763	764
1842	765	766	767	768
1843	769	770	771	772
1844	773	774	775	776
1845	777	778	779	780
1846	781	782	783	784
1847	785	786	787	788
1848	789	790	791	792
1849	793	794	795	796
1850	797	798	799	800
1851	801	802	803	804
1852	805	806	807	808
1853	809	810	811	812
1854	813	814	815	816
1855	817	818	819	820
1856	821	822	823	824
1857	825	826	827	828
1858	829	830	831	832
1859	833	834	835	836

YEAR	1st	2nd	3rd	4th
1860	837	838	839	840
1861	841	842	843	844
1862	845	846	847	848
1863	849	850	851	852
1864	853	854	855	856
1865	857	858	859	860
1866	861	862	863	864
1867	865	866	867	868
1868	869	870	871	872
1869	873	874	875	876
1870	877	878	879	880
1871	881	882	883	884
1872	885	886	887	888
1873	889	890	891	892
1874	893	894	895	896
1875	897	898	899	900
1876	901	902	903	904
1877	905	906	907	908
1878	909	910	911	912
1879	913	914	915	916
1880	917	918	919	920
1881	921	922	923	924
1882	925	926	927	928
1883	929	930	931	932
1884	933	934	935	936
1885	937	938	939	940
1886	941	942	943	944
1887	945	946	947	948
1888	949	950	951	952
1889	953	954	955	956
1890	957	958	959	960
1891	961	962	963	964
1892	965	966	967	968
1893	969	970	971	972
1894	973	974	975	976
1895	977	978	979	980
1896	981	982	983	984
1897	985	986	987	988
1898	989	990	991	992
1899	993	994	995	996
1900	997	998	999	1000
1901	1001	1002	1003	1004
1902	1005	1006	1007	1008
1903	1009	1010	1011	1012
1904	1013	1014	1015	1016
1905	1017	1018	1019	1020
1906	1021	1022	1023	1024
1907	1025	1026	1027	1028
1908	1029	1030	1031	1032
1909	1033	1034	1035	1036
1910	1037	1038	1039	1040
1911	1041	1042	1043	1044
1912	1045	1046	1047	1048
1913	1049	1050	1051	1052
1914	1053	1054	1055	1056
1915	1057	1058	1059	1060
1916	1061	1062	1063	1064
1917	1065	1066	1067	1068
1918	1069	1070	1071	1072
1919	1073	1074	1075	1076

YEAR	1st	2nd	3rd	4th
1920	1077	1078	1079	1080
1921	1081	1082	1083	1084
1922	1085	1086	1087	1088
1923	1089	1090	1091	1092
1924	1093	1094	1095	1096
1925	1097	1098	1099	1100
1926	1101	1102	1103	1104
1927	1105	1106	1107	1108
1928	1109	1110	1111	1112
1929	1113	1114	1115	1116
1930	1117	1118	1119	1120
1931	1121	1122	1123	1124
1932	1125	1126	1127	1128
1933	1129	1130	1131	1132
1934	1133	1134	1135	1136
1935	1137	1138	1139	1140
1936	1141	1142	1143	1144
1937	1145	1146	1147	1148
1938	1149	1150	1151	1152
1939	1153	1154	1155	1156
1940	1157	1158	1159	1160
1941	1161	1162	1163	1164
1942	1165	1166	1167	1168
1943	1169	1170	1171	1172
1944	1173	1174	1175	1176
1945	1177	1178	1179	1180
1946	1181	1182	1183	1184
1947	1185	1186	1187	1188
1948	1189	1190	1191	1192
1949	1193	1194	1195	1196
1950	1197	1198	1199	1200
1951	1201	1202	1203	1204
1952	1205	1206	1207	1208
1953	1209	1210	1211	1212
1954	1213	1214	1215	1216
1955	1217	1218	1219	1220
1956	1221	1222	1223	1224
1957	1225	1226	1227	1228
1958	1229	1230	1231	1232
1959	1233	1234	1235	1236
1960	1237	1238	1239	1240
1961	1241	1242	1243	1244
1962	1245	1246	1247	1248
1963	1249	1250	1251	1252
1964	1253	1254	1255	1256
1965	1257	1258	1259	1260
1966	1261	1262	1263	1264
1967	1265	1266	1267	1268
1968	1269	1270	1271	1272
1969	1273	1274	1275	1276
1970	1277	1278	1279	1280
1971	1281	1282	1283	1284
1972	1285	1286	1287	1288
1973	1289	1290	1291	1292
1974	1293	1294	1295	1296
1975	1297	1298	1299	1300
1976	1301	1302	1303	1304
1977	1305	1306	1307	1308
1978	1309	1310	1311	1312
1979	1313	1314	1315	1316

ADDENDA

Through a mechanical error, Table 14 of the European Partridge article in the summer issue of the Journal of Cycle Research (Vol. 11, No. 2) became separated and the table left out. It is included here.

Table 14

Synthesis of Nine European Partridge Cycles

Year	Value of 22.71-Year Cycle	Value of 13.95-Year Cycle	Value of 11.84-Year Cycle	Value of 8.33-Year Cycle	Value of 8.05-Year Cycle	Value of 5.09-Year Cycle	Value of 4.14-Year Cycle	Combined Seven Cycles	Partridge Residual (seven cycles removed)
1727	2.107	1.919	2.093	1.978	1.972	1.963	2.000	2.032	2.037
1728	2.087	1.895	2.066	1.949	1.972	2.009	2.032	2.010	1.759
1729	2.047	1.860	2.011	1.970	1.990	2.036	2.000	1.934	2.226
1730	1.993	1.912	1.960	1.989	2.010	2.010	1.970	1.844	2.315
1731	1.953	1.951	1.921	2.009	2.029	1.984	2.000	1.847	2.291
1732	1.918	1.982	1.903	2.029	2.029	1.963	2.032	1.856	2.090
1733	1.887	2.016	1.915	2.051	2.010	2.009	2.000	1.888	1.960
1734	1.860	2.057	1.954	2.019	1.990	2.036	1.970	1.886	1.969
1735	1.843	2.095	2.000	1.978	1.972	2.010	2.000	1.898	2.163
1736	1.835	2.140	2.041	1.949	1.972	1.984	2.032	1.953	1.997
1737	1.840	2.115	2.073	1.970	1.990	1.963	2.000	1.951	2.070
1738	1.865	2.076	2.097	1.989	2.010	2.009	1.970	2.016	2.283
1739	1.893	2.010	2.093	2.009	2.029	2.036	2.000	2.070	1.873
1740	1.925	1.956	2.066	2.029	2.029	2.010	2.032	2.047	2.010
1741	1.968	1.919	2.011	2.051	2.010	1.984	2.000	1.943	2.087
1742	2.026	1.895	1.960	2.019	1.990	1.963	1.970	1.823	2.002
1743	2.072	1.860	1.921	1.988*	1.972	2.009	1.997*	1.819	2.007
1744	2.103	1.912	1.903	1.978	1.972	2.036	2.000	1.904	1.947
1745	2.132	1.951	1.915	1.949	1.990	2.010	2.032	1.979	2.014
1746	2.154	1.982	1.954	1.970	2.010	1.984	2.000	2.054	2.047
1747	2.165	2.016	2.000	1.989	2.029	1.963	1.970	2.132	2.032
1748	2.160	2.057	2.041	2.009	2.029	2.009	2.000	2.305	1.389
1749	2.142	2.095	2.073	2.029	2.010	2.036	2.032	2.417	1.865
1750	2.117	2.140	2.097	2.051	1.990	2.010	2.000	2.405	1.863
1751	2.087	2.115	2.093	2.019	1.972	1.984	1.970	2.240	1.781
1752	2.047	2.076	2.066	1.978	1.972	1.959*	2.000	2.098	1.860
1753	1.993	2.010	2.011	1.949	1.990	1.963	2.032	1.948	2.052
1754	1.953	1.956	1.960	1.970	2.010	2.009	2.000	1.858	2.212
1755	1.918	1.919	1.921	1.989	2.029	2.036	1.970	1.782	2.071
1756	1.887	1.895	1.903	2.009	2.029	2.010	2.000	1.733	2.055
1757	1.860	1.860	1.915	2.029	2.010	1.984	2.032	1.690	2.270
1758	1.843	1.912	1.954	2.051	1.990	1.963	2.000	1.713	2.022
1759	1.835	1.951	2.000	2.019	1.972	2.009	1.970	1.756	2.029
1760	1.840	1.982	2.041	1.978	1.972	2.036	2.000	1.849	2.095
1761	1.865	2.016	2.073	1.949	1.990	2.010	2.032	1.935	2.023
1762	1.893	2.057	2.097	1.970	2.010	1.984	2.000	2.011	2.046
1763	1.925	2.095	2.093	1.989	2.029	1.963	1.970	2.064	1.967
1764	1.968	2.140	2.066	2.009	2.029	2.009	2.000	2.221	1.998
1765	2.026	2.115	2.011	2.029	2.010	2.036	2.032	2.259	2.044
1766	2.072	2.076	1.960	2.051	1.990	2.010	2.000	2.159	1.867
1767	2.103	2.010	1.921	2.019	1.972	1.984	1.970	1.979	1.983
1768	2.132	1.956	1.903	1.988*	1.972	1.963	2.000	1.914	1.847
1769	2.154	1.919	1.915	1.978	1.990	2.009	2.032	1.997	2.043
1770	2.165	1.895	1.954	1.949	2.010	2.036	2.000	2.009	2.283
1771	2.160	1.860	2.000	1.970	2.029	2.010	1.970	1.999	1.904
1772	2.142	1.912	2.041	1.989	2.029	1.984	1.997*	2.094	1.957
1773	2.117	1.951	2.073	2.009	2.010	1.963	2.000	2.123	1.969
1774	2.087	1.982	2.097	2.029	1.990	2.009	2.032	2.226	1.958
1775	1.993*	2.016	2.093	2.051	1.972	2.036	2.000	2.161	2.170
1776	1.953	2.057	2.066	2.019	1.972	2.010	1.970	2.047	2.109
1777	1.918	2.095	2.011	1.978	1.990	1.984	2.000	1.976	1.982
1778	1.887	2.140	1.960	1.949	2.010	1.963	2.032	1.941	1.937
1779	1.860	2.115	1.921	1.970	2.029	2.009	2.000	1.904	1.977
1780	1.843	2.076	1.903	1.989	2.029	2.036	1.970	1.846	2.180
1781	1.835	2.010	1.915	2.009	2.010	2.010	2.000	1.789	2.126
1782	1.840	1.956	1.954	2.029	1.990	1.984	2.032	1.785	2.142
1783	1.865	1.919	2.041*	2.041	2.051	1.972	1.963	1.811	1.942
1784	1.893	1.895	2.073	2.019	1.972	2.009	1.970	1.831	1.925
1785	1.925	1.860	2.097	1.978	1.990	2.036	2.000	1.886	2.101
1786	1.968	1.912	2.093	1.949	2.010	2.010	2.032	1.974	1.692
1787	2.026	1.951	2.066	1.970	2.029	1.984	2.000	2.026	1.853
1788	2.072	1.982	2.011	1.989	2.029	1.963	1.970	2.016	1.959
1789	2.103	2.016	1.960	2.009	2.010	2.009	2.000	2.107	1.945
1790	2.132	2.057	1.921	2.029	1.990	2.036	2.032	2.197	1.943
1791	2.154	2.095	1.903	2.051	1.972	2.010	2.000	2.185	2.051
1792	2.165	2.140	1.915	2.019	1.972	1.984	1.970	2.165	2.043
1793	2.160	2.115	1.954	1.988*	1.990	1.963	2.000	2.170	2.007
1794	2.142	2.076	2.000	1.978	2.010	2.009	2.032	2.247	2.105
1795	2.117	2.010	2.041	1.949	2.029	2.036	2.000	2.182	2.113
1796	2.087	1.956	2.073	1.970	2.029	2.010	1.970	2.095	1.908
1797	2.047	1.919	2.097	1.989	2.010	1.984	2.000	2.046	1.927
1798	1.993	1.895	2.093	2.009	1.990	1.963	2.032	1.975	2.041
1799	1.953	1.860	2.066	2.029	1.972	2.009	2.000	1.889	2.194
1800	1.918	1.912	2.011	2.051	1.972	2.036	1.970	1.870	2.198
1801	1.887	1.951	1.960	2.019	1.990	2.010	1.997*	1.814	1.799
1802	1.860	1.982	1.921	1.978	2.010	1.984	2.000	1.735	1.935
1803	1.843	2.016	1.903	1.949	2.029	1.963	2.032	1.735	1.814
1804	1.835	2.057	1.915	1.970	2.029	2.009	2.000	1.815	1.738
1805	1.840	2.095	1.954	1.989	2.010	2.036	1.970	1.894	1.836
1806	1.865	2.140	2.000	2.009	1.990	2.010	2.000	2.014	2.172
1807	1.893	2.115	2.041	2.029	1.972	1.984	2.032	2.066	2.019
1808	1.925	2.076	2.073	2.051	1.972	1.959*	2.000	2.056	2.053
1809	1.968	2.010	2.097	2.019	1.990	1.963	1.970	2.017	2.059
1810	2.026	1.956	2.093	1.978	1.990*	2.009	2.000	2.052	2.057
1811	2.072	1.919	2.066	1.949	2.010	2.036	2.032	2.084	1.999
1812	2.103	1.895	2.011	1.970	2.029	2.010	2.000	2.018	2.041
1813	2.132	1.860	1.960	1.989	2.029	1.984	1.970	1.924	2.055
1814	2.154	1.912	1.921	2.009	2.010	1.963	2.000	1.969	2.091
1815	2.165	1.951	1.903	2.029	1.990	2.009	2.032	2.079	2.012
1816	2.160	1.982	1.915	2.051	1.972	2.036	2.000	2.118	1.991
1817	2.142	2.016	1.954	2.019	1.972	2.010	1.970	2.083	2.124
1818	2.117	2.057	2.000	1.988*	1.990	1.984	2.000	2.136	2.095
1819	2.087	2.095	2.041	1.978	2.010	1.963	2.032	2.206	1.999
1820	2.047	2.140	2.073	1.949	2.029	2.009	2.000	2.247	1.996
1821	1.993	2.115	2.097	1.970	2.029	2.036	1.970	2.210	1.818
1822	1.953	2.076	2.093	1.989	2.010	2.010	2.000	2.131	1.859
1823	1.918	2.010	2.066	2.009	1.990	1.984	2.032	2.009	1.888
1824	1.887	1.956	2.011	2.029	1.972	1.963	2.000	1.818	2.002
1825	1.860	1.919	1.960	2.051	1.972	2.009	1.970	1.741	2.070
1826	1.8[illegible]	1.895	1.921	2.019	1.990	2.036	2.000	1.704	1.952
1827	1.835	1.860	1.903	1.978	2.010	2.010	2.032	1.628	2.049
1828	1.840	1.912	1.915	1.949	2.029	1.984	2.000	1.629	2.093
1829	1.865	1.951	1.954	1.970	2.029	1.963	1.970	1.702	2.054
1830	1.993	1.982	2.000	1.989	2.010	2.009	1.997*	1.880	1.939
1831	1.925	2.016	2.041	2.009	1.990	2.036	2.000	2.017	2.137
1832	1.968	2.057	2.073	2.029	1.972	2.010	2.032	2.141	2.049
1833	2.026	2.095	2.097	2.051	1.972	1.984	2.000	2.225	1.904
1834	2.072	2.140	2.093	2.019	1.990	1.953	1.970	2.247	2.000
1835	2.103	2.115	2.066	1.978	2.010	2.009	2.000	2.281	1.883
1836	2.132	2.076	2.011	1.949	2.029	2.036	2.032	2.265	1.982
1837	2.154	2.010	1.960	1.970	2.029	2.010	2.000	2.133	2.139
1838	2.165	1.956	1.921	1.989	2.010	1.984	1.970	1.995	2.086
1839	2.160	1.919	1.903	2.009	1.990	1.963	2.000	1.944	2.154
1840	2.142	1.895	1.915	2.029	1.972	2.009	2.032	1.994	2.150
1841	2.117	1.860	1.954	2.051	1.972	2.036	2.000	1.990	1.960
1842	2.087	1.912	2.000	2.019	1.990	2.010	1.970	1.988	1.993
1843	2.047	1.951	2.041	1.988*	2.010	1.984	2.000	2.021	1.951
1844	1.993	1.982	2.073	1.978	2.029	1.963	2.032	2.050	2.010
1845	1.953	2.016	2.097	1.949	2.029	2.009	2.000	2.053	1.964
1846	1.918	2.057	2.093	1.970	2.010	2.036	1.970	2.054	1.885
1847	1.887	2.095	2.066	1.989	1.990	2.010	2.000	2.037	1.848
1848	1.860	2.140	2.011	2.009	1.972	1.984	2.032	2.008	2.008
1849	1.843	2.115	1.960	2.029	1.972	1.963	2.000	1.882	2.073
1850	1.835	2.076	1.921	2.051	1.990	2.009	1.970	1.852	2.123
1851	1.840	2.010	1.903	2.019	2.010	2.036	2.000	1.818	1.886
1852	1.865	1.956	1.915	1.978	2.029	2.010	2.032	1.785	1.971
1853	1.893	1.919	1.954	1.949	2.029	1.984	2.000	1.728	2.084
1854	1.925	1.895	2.041*	1.970	2.010	1.963	1.970	1.774	2.019
1855	1.968	1.860	2.073	1.989	1.990	2.009	2.000	1.889	1.948
1856	2.026	1.912	2.097	2.009	1.972	2.036	2.032	2.084	1.981
1857	2.072	1.951	2.093	2.029	1.972	2.010	2.000	2.127	1.973
1858	2.103	1.982	2.066	2.051	1.990	1.984	1.970	2.146	1.906
1859	2.132	2.016	2.011	2.019	2.010	1.963	2.000	2.151	1.967
1860	2.154	2.057	1.960	1.978	2.029	2.009	2.032	2.219	1.923
1861	2.165	2.095	1.921	1.949	2.029	2.036	2.000	2.194	1.928
1862	2.160	2.140	1.903	1.970	2.010	2.010	1.970	2.163	1.996
1863	2.142	2.115	1.915	1.989	1.990	1.984	1.997*	2.132	2.028
1864	2.117	2.076	1.954	2.009	1.972	1.959*	2.000	2.087	2.052
1865	2.087	2.010	2.000	2.029	1.972	1.963	2.032	2.093	2.054
1866	1.993*	1.956	2.041	2.051	1.990	2.009	2.000	2.040	1.876
1867	1.953	1.919	2.073	2.019	2.010	2.036	1.970	1.980	1.937
1868	1.918	1.895	2.097	1.988*	2.029	2.010	2.000	1.937	1.945
1869	1.887	1.860	2.093	1.978	2.029	1.984	2.032	1.843	2.029
1870	1.860	1.912	2.066	1.949	2.010	1.963	2.000	1.760	2.159
1871	1.843	1.951	2.011	1.970	1.990	2.009	1.970	1.744	2.053
1872	1.835	2.016*	1.960	1.989	1.972	2.036	2.000	1.808	1.994
1873	1.840	2.057	1.921	2.009	1.972	2.010	2.032	1.841	1.948
1874	1.865	2.095	1.903	2.029	1.990	1.984	2.000	1.866	1.868
1875	1.893	2.140	1.915	2.051	2.010	1.963	1.970	1.942	1.930
1876	1.925	2.115	1.954	2.019	2.029	2.009	2.000	2.051	2.038
1877	1.968	2.076	2.000	1.978	2.029	2.036	2.032	2.119	1.995
1878	2.026	2.010	2.041	1.949	2.010	2.010	2.000	2.046	1.905
1879	2.072	1.956	2.073	1.970	1.990	1.984	1.970	2.015	2.027
1880	2.103	1.919	2.097	1.989	1.972	1.963	2.000	2.043	2.034
1881	2.132	1.895	2.093	2.009	1.972	2.009	2.032	2.142	1.938
1882	2.154	1.860	2.066	2.029	1.990	2.036	2.000	2.135	2.011
1883	2.165	1.912	2.011	2.051	2.010	2.010	1.970	2.129	1.915
1884	2.160	1.951	1.960	2.019	2.029	1.984	2.000	2.103	2.041
1885	2.142	1.982	1.921	1.978	2.029	1.963	2.032	2.047	2.143
1886	2.117	2.016	1.903	1.949	2.010	2.009	2.000	2.004	2.063
1887	2.087	2.057	1.915	1.970	1.990	2.036	1.970	2.025	2.030
1888	2.047	2.095	1.954	1.989	1.972	2.010	2.000	2.067	1.926
1889	1.993	2.140	2.000	2.009	1.972	1.984	2.032	2.130	1.969
1890	1.953	2.115	2.041	2.029	1.990	1.963	2.000	2.091	1.973
1891	1.918	2.076	2.073	2.051	2.010	2.009	1.970	2.107	2.009
1892	1.887	2.010	2.097	2.019	2.029	2.036	1.997*	2.075	1.950
1893	1.860	1.956	2.093	1.988*	2.029	2.010	2.000	1.935	2.162
1894	1.843	1.919	2.066	1.978	2.010	1.984	2.032	1.832	2.274
1895	1.835	1.895	2.011	1.949	1.990	1.963	2.000	1.643	1.988
1896	1.840	1.860	1.960	1.970	1.972	2.009	1.970	1.581	1.995
1897	1.865	1.912	1.921	1.989	1.972	2.036	2.000	1.695	2.035
1898	1.893	1.951	1.903	2.009	1.990	2.010	2.032	1.788	2.276
1899	1.925	1.982	1.915	2.029	2.010	1.984	2.000	1.845	2.263
1900	1.968	2.016	1.954	2.051	2.029	1.963	1.970	1.951	2.182
1901	2.026	2.057	2.000	2.019	2.029	2.009	2.000	2.140	2.026
1902	2.072	2.095	2.041	1.978	2.010	2.036	2.032	2.264	1.923
1903	2.103	2.140	2.073	1.949	1.990	2.010	2.000	2.265	2.023
1904	2.132	2.115	2.097	1.970	1.972	1.984	1.970	2.240	2.041
1905	2.154	2.076	2.093	1.989	1.972	1.963	2.000	2.247	2.100
1906	2.165	2.010	2.066	2.009	1.990	2.009	2.032	2.281	1.868
1907	2.160	1.956	2.011	2.029	2.010	2.036	2.000	2.302	1.860
1908	2.142	1.919	1.960	2.051	2.029	2.010	1.970	2.061	1.980
1909	2.117	1.895	1.921	2.019	2.029	1.984	2.000	1.963	1.652

*Interpolated values